CONVERSION AT STEPNOGORSK: WHAT THE FUTURE HOLDS FOR FORMER BIOWEAPONS FACILITIES

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EXECUTIVE SUMMARY

This study examines the ongoing efforts to convert a former biological weapons (BW) facility in Stepnogorsk, Kazakhstan. The facility, known in the Soviet period as the Stepnogorsk Scientific and Experimental Production Base (SNOPB), was the USSR's largest mobilization facility dedicated to the production and weaponization of anthrax bacteria. Since the collapse of the Soviet Union, the Kazakh government has demonstrated its commitment to nonproliferation and international security by opening and providing full transparency into the facility. The Kazakh government has issued mandates for a number of restructuring changes and conversion efforts at the facility. Subsequent U.S. and international assistance have played key roles in dismantling the facility and redirecting its personnel to peaceful purposes. Yet, the continuing economic and political instability in Kazakhstan maintains concerns regarding the threat of proliferation involving former BW personnel from the facility.

Because biotechnology is inherently dual-use, many have touted the conversion of former Soviet BW facilities as more simple and straightforward than converting other Soviet defense facilities. This study shows the contrary. Because of the unique characteristics present within BW facilities, as well as the peculiar political, economic, and social environment in the former Soviet Union, conversion of BW facilities like Stepnogorsk will likely be as difficult, if not more difficult, than their nuclear or chemical counterparts. These factors, as well as a general lack of understanding about what is needed for conversion of Soviet defense facilities, can help explain why all conversion efforts at Stepnogorsk have failed thus far.

Today, perhaps the most serious proliferation threat from this facility comes from the knowledge possessed by the forty bioweaponeers that remain. Several of these individuals have 20 or more years working on all stages of BW development, production, and weaponization. Although this "brain drain" problem is poorly understood, addressing this threat should remain a U.S. and international security priority. One of the most important instruments to deal with this threat involves converting these personnel to peaceful, economically sustainable activities. Although this fact is well recognized by the U.S. and Kazakh governments, all conversion efforts to date have failed.

In spite of these previously failed efforts, this study will propose specific recommendations to address these difficulties and recommend new approaches and strategies to re-start conversion efforts at Stepnogorsk. The Stepnogorsk case does not imply that U.S. and international assistance must fund long-term economically sound conversion at every former Soviet BW facility. Instead, each BW facility will have different characteristics influencing their proliferation potential and ability to convert. These characteristics must be identified and analyzed to design appropriate, effective, and cost-efficient nonproliferation policies for each facility.

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We would also like to thank a number of U.S. government officials from the House and Senate Armed Services Committees, the Departments of Agriculture, Defense, Energy, and State, as well as the Civilian Research and Development Foundation, Defense Threat Reduction Agency, and Environmental Protection Agency. Officials with the International Science and Technology Center also provided valuable information to this project. In addition, interviews with individuals from Allen and Associates, International Science Applications International Corporation, and Bechtel Group, Inc. provided important on-the-ground insights regarding U.S. assistance. In spite of our desire to recognize many of these individuals for their contributions to this work, they would prefer to remain anonymous. We offer special thanks to the managing team of the Stepnogorsk facility, Dr. Gennady Lepyoshkin, Dr. Vladimir Bugreev, Dr. Alexander Kossinov, and Mr. Yuri Rufov, and to their staff for their willingness to meet with us and discuss conversion efforts at Stepnogorsk, as well as allowing us to tour their production facility and new laboratories. We also wish to thank Dr. Ken Alibek for historical information regarding past activities at Stepnogorsk. We appreciate these additional reviewers for their valuable comments in improving this paper from its draft form: David Bernstein, William Ghiorse, Gregory Gleason, Stacy Gunther, Frank von Hippel, Sharon Weiner, and an anonymous Russian scientist. Finally, we would like to thank Sandra Kisner and Elaine Scott in the Peace Studies Program at Cornell University for their administrative and editorial assistance in the preparation and publication of this paper.

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We hope that this study will promote open discussion on the former Soviet BW complex that can assist all stakeholders and interested parties in formulating, refining, and implementing appropriate policy responses. We welcome additional comments and reactions to this study.

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I. INTRODUCTION

Biological Weapons (BW) are defined here as the use of living microorganisms or their derivatives to cause incapacitation or death in humans. Some factors that are important for microorganisms to be used as biological weapons are virulence, infectivity, stability/ruggedness, ease of producibility, and ease of controllability. History reveals that only a small number of microorganisms have possessed the right combination of these characteristics to be useful as biological weapons against humans. These agents include anthrax, plague, smallpox, glanders, and tularemia.[1] Key steps involved in obtaining a potent BW capability causing large-scale deaths include: (1) acquiring virulent strains; (2) growing biological agents; (3) formulating the biological agents for weaponization; (4) developing a means of delivery; and (5) effectively disseminating the agent. Achieving all of these steps is difficult. A study of state-sponsored offensive programs indicates that production of potent and effective biological weapons has involved a significant investment of expertise, infrastructure, and resources.[2]

It is clear that the Soviet BW program developed the largest and most advanced offensive BW program in history.[3] Through intelligence information and defectors we know that the Soviet BW program involved thousands of scientists and technical staff, spread across multiple institutes and regions. These Soviet bioweaponeers utilized new fermentation processes, molecular biology techniques, and engineering methods to develop sophisticated tactical and strategic biological weapons. Due to the unstable economic, political, and social situation now facing the former Soviet republics, there is concern that the materials and expertise associated with the Soviet BW program could be acquired illicitly by other states or terrorist groups.

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[1] There are other pathogens that could be developed as weapons to harm plants and animals and incapacitate humans. A list of these potential biowarfare agents can be found in Central Intelligence Agency, *The Biological & Chemical Warfare Threat*, rev. ed. (Washington, DC: U.S. Government Printing Office, 1999), 13-14.

[2] To date, there are conflicting perspectives on the interest and ability of non-state actors to use BW to cause mass casualty attacks. See Brad Roberts, ed., *Hype or Reality? The "New Terrorism" and Mass Casualty Attacks* (Alexandria, VA: Chemical and Biological Arms Control Institute, 2000).

[3] Ken Alibek with Stephen Handelman, *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World, Told From Inside By the Man Who Ran It* (New York: Random House, 1999); Milton Leitenberg, "Biological Arms Control," *Contemporary Security Policy* 17, no. 1 (April 1996): 1-79; Anthony Rimmington, "Invisible Weapons of Mass Destruction: The Soviet Union's BW Programme and its Implications for Contemporary Arms Control," *Journal of Slavic Military Studies* 13, no. 3 (September 2000): 1-46.

This prospect has not gone unnoticed. A recent U.S. government report finds that since 1997, countries of proliferation concern have intensified their efforts to acquire biological weapons expertise from at least 15 former Soviet biological weapons institutes.[4] In particular, Iran has been aggressively recruiting former Soviet BW scientists. In 1991, Gennady Lepyoshkin, the former director of the Stepnogorsk BW production facility, said that he had been approached by Iranian middlemen who disguised themselves as private businessmen looking for joint biotech commercial ventures. Although Lepyoshkin was looking for foreign investment, he states, "Their proposals were such that we immediately declined and ceased contact with them."[5]

Although rebuffed in Kazakhstan, Iranian officials continued their recruitment efforts. A scientific advisor for Iranian President Mohammad Khatami and delegations of Iranian clerics have traveled to several former Soviet BW facilities seeking research collaborations involving a variety of pathogens, as well as exchanges for broader scientific training in genetic engineering techniques. These discussions have included proposed salaries of $5,000 a month.[6] Russian scientists have acknowledged that at least five of their colleagues have gone to work in Iran for either consultancy or teaching contracts. For example, in 1997, Iranian officials visited the All-Russian Institute of Phytopathology in Golitsino, Russia. This visit was designed to explore possibilities for scientific exchanges on plant pathology projects. It is known that four scientists from this facility have visited Tehran on business trips. That same year, the Russian Ministry of Science and Technology sponsored a biotechnology trade fair in Tehran. More than 100 leading biologists from former Soviet BW institutes attended the meeting. American and Russian government officials admit that these recruitment efforts have continued.[7] This raises the concern

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[4] U.S. General Accounting Office, *Biological Weapons: Effort To Reduce Former Soviet Threat Offers Benefits, Poses New Risks: Report to Congressional Requesters*, GAO/NSIAD-00-138 (Washington, DC: U.S. General Accounting Office, April 2000), p. 14.

[5] Judith Miller and William J. Broad, "Iranians, Bioweapons in Mind, Lure Needy Ex-Soviet Scientists," *New York Times*, 8 December 1998, sec. A, p. 1.

[6] Ibid.

[7] Central Intelligence Agency, *Unclassified Report to Congress*; Judith Miller, "Flying Blind in a Dangerous World," *New York Times*, 6 February 2000, p. D5.

that some knowledge associated with former Soviet BW technology may be transferred to countries hostile to the United States.[8]

To date, however, it appears that few BW scientists have left the former Soviet republics to work in countries of proliferation concern. Milton Leitenberg, a biological weapons expert, finds that by 1997 a few hundred scientists had left the Russian Biopreparat BW establishment.[9] Of these, approximately 90 percent had gone to either Israel, Western European countries, or the United States.[10] Of the remaining 10 percent, the majority of these scientists had gone to work in developing countries that do not have BW programs. Therefore, as of 1997, only a small number of former Soviet BW scientists were either known to be working in countries of proliferation concern or whose whereabouts were unknown. Yet, it is difficult to gauge the impact that these scientists or additional "brain drain" cases might have on developing state BW programs.

The transfer of BW-sensitive technology from Russia and the New Independent States to countries of proliferation concern is troubling. For example, Iraq is known to have sought dual-use biological equipment from Russia. In the fall of 1997, the United Nations Special Commission on Iraq (UNSCOM) discovered a confidential document outlining negotiations between Russia and Iraq to construct a single cell protein (SCP) factory in Iraq. The proposed factory would have included the installation of 50,000-liter fermentors. Both Iraqi and Russian sources state that the facility would have been used to support the production of animal feed. From UNSCOM investigations, however, it is known that Iraq has previously used SCP plants, such as its Al-Hakam facility, for clandestine production of anthrax and botulinum toxin. Richard Butler, former chairman of UNSCOM, has stated that, "the documents show that the Russian side pre-

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[8] In addition to the recruitment of Soviet scientists, other instances have been documented of proliferant countries seeking expertise from former state offensive BW programs. U.S. intelligence reports that when the offensive portion of the Ft. Detrick BW facility closed down in the early 1970s, some U.S. bioweaponeers formed a consortium and approached a then-friendly foreign government to offer their services. Fortunately, the proposed venture was thwarted by the U.S. government. Milton Leitenberg speculates that the country involved was Iran. Reports emerged in 1995 that Libya's Colonel Qaddafi was trying to recruit Woulter Basson, head of South Africa's BW program. The U.S. and U.K. governments put pressure on the South African government to block these efforts. See Wendy Orent, "After Anthrax," *The American Prospect*, 8 May 2000, p. 18; Milton Leitenberg, "Biological Weapons in the Twentieth Century: A Review and Analysis," at http://www.fas.org/bwc/papers/bw20th.htm; Chandre Gould and Peter I. Folb, "The South African Chemical and Biological Warfare Program: An Overview," *Nonproliferation Review* 7, no. 3 (Fall-Winter 2000): 20-21; James Adams, "Gadaffi Lures South Africa's Top Germ Warfare Scientists," *Sunday Times*, 26 February 1995.

[9] Milton Leitenberg, telephone interview with Kathleen M. Vogel, 19 October 2001.

[10] Milton Leitenberg, "Biological Weapons in the Twentieth Century."

sented an offer to the Iraqi delegation and that Iraq's Military Industrialization Corporation later decided to accept it."[11] The Russian government has admitted that representatives from Russian companies and one Russian government official met with Iraqi officials in 1995 to negotiate this sale, although official statements declare that these negotiations never resulted in a signed contract.[12] If successful, this transaction would have violated a UN authorized embargo on sales of such dual-use equipment to Iraq. Although Russia and Iraq both deny that any sensitive exports occurred, there is continuing suspicion that some fermentation equipment was exported. Exports of dual-use materials and equipment from a range of countries have benefited Iraq's prior offensive BW program.[13] Poor implementation of export control and customs systems in Russia and the New Independent States raise continuing concerns over leakage of BW technology.[14]

During the Soviet period, the republic of Kazakhstan became an important location for extensive research and development (R&D), production, and testing of the USSR's weapons systems. Approximately fifty military facilities in Kazakhstan were associated with the former Soviet weapons complex. Although small in comparison to the thousands of defense enterprises in Russia, several of these Kazakh facilities emerged as key elements in their own right. For example, two of the most famous Soviet weapons facilities were the Semipalatinsk nuclear test site and Baikonur Cosmodrome, both located in Kazakhstan.

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[11] R. Jeffrey Smith, "Russians Admit Firms met Iraqis; Plant That Could Make Germs Weapons at Issue," *Washington Pos*t, 18 February 1998, p. A16.

[12] Judith Miller, "Standoff With Iraq: The Dealings," *New York Times*, 18 February 1998, p. A8.

[13] Iraq is known to have received strains of BW agents such as *Bacillus anthracis*, *Clostridium botulinum*, *Brucella melitenis*, *Yersinia pestis*, and other pathogens from the American Type Culture Collection. A Danish company supplied Iraq with two spray dryers; Italian, Swiss, and German firms supplied fermentors to Iraq. Italy also supplied Iraq with several hundred aerosol dispersal systems. Michael Barletta and Christina Ellington, "Foreign Suppliers to Iraq's Biological Weapons Program," at http://cns.miis.edu/research/wmdme/flow/iraq/index.htm, accessed 1 December 2001; Raymond A. Zilinskas, "Iraq's Biological Warfare Program: The Past as Future?" in *Biological Weapons: Limiting the Threat*, ed. Joshua Lederberg (Cambridge: MIT Press, 1999), p. 141.

[14] Sonia Ben Ouagrham, "Biological Weapons Threats from the Former Soviet Union," (forthcoming); Michael Beck, "Russia and Efforts to Establish Export Controls," at http://www.uga.edu/cits/ttxc/nat_eval_russia.htm, accessed 8 August 2002; Keith D. Wolfe, "An Evaluation of Export Control in Kazakhstan," at http://www.uga.edu/cits/ttxc/nat_eval_kazakhstan.htm, accessed 8 August 2002.

Less commonly known is that Kazakhstan housed several important components of the Soviet BW program. The Almaty Anti-Plague Research Institute,[15] Otar's Scientific Agricultural Research Institute, the Stepnogorsk Scientific and Experimental Production Base, and the Vozrozhdeniye Island test site played key roles in Soviet BW activities (see Figure 1). Due to the secrecy and compartmentalization of the USSR's BW program, many of these facilities were not known to local Kazakh Communist party officials. In fact, many of the directors and personnel of these Kazakh BW facilities did not even know about the existence of other BW facilities within Kazakhstan.

Fig. 1: Map of Kazakhstan and Former Soviet BW Facilities Located on Kazakh Territory

Source: personal communication, U.S. government official

With the break-up of the Soviet Union, the new independent country of Kazakhstan inherited key facilities, equipment, and personnel associated with the USSR BW program. During the early years of nation building the new Kazakh government strove to find out about the Soviet

[15] In April 2001, the Anti-Plague Institute was renamed by government decision. The new name of the facility is The Scientific Center for Quarantine and Zoonotic Infections.

weapons legacy left within its borders. As the magnitude of the remaining military-industrial complex was realized, the Kazakh government struggled to determine how to deal with these weapons personnel and facilities. In the transition period and thereafter, Kazakhstan's dire economic situation has led to downsizing and restructuring of these facilities. Such changes under a short time frame have made it difficult for these facilities to adapt to a market economy and convert to peaceful work. This environment has created an unstable and uncertain future for many of these facilities and their weapons specialists. These conditions raise the concern that technology and expertise associated with former Soviet BW facilities in Kazakhstan may leak to hostile entities, posing a serious threat to international security.

To date, much attention has been directed at the risks of proliferation involving nuclear weapons and weapons expertise from the former Soviet Union. Yet, few studies in the open literature have examined the complex interplay of economic and proliferation problems associated with the residual BW establishment left in Russia and the New Independent States (NIS). Part of the reason is the continuing secrecy regarding Soviet BW activities in these countries, as well as the small number of researchers who have undertaken concerted efforts to study this program in detail. In spite of these issues, several core academic papers on the general subject have been published.

The primary academic work covering historical aspects of the former Soviet complex are found in papers and books from Ken Alibek, Igor Domaradsky, Tom Mangold, Gulbarshyn Bozheyeva et al. from the Monterey Institute of International Studies, Milton Leitenberg at the University of Maryland, and Anthony Rimmington at the University of Birmingham.[16] These studies have provided a wealth of information on the history and structural organization of the BW program. Other recent studies have examined the current situation of former BW facilities

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[16] Alibek and Handelman, Biohazard; Igor Domaradsky, "Znanie—Sila, The History of One Risky Venture," November 1996, unpublished manuscript; Gulbarshyn Bozheyeva, Yerlan Kunakbayev, and Dastan Yeleukenov, *Former Soviet Biological Weapons Facilities in Kazakhstan: Past, Present, and Future*, Occasional Paper No. 1 (Monterey: Monterey Institute of International Studies, June 1999); Milton Leitenberg, "Biological Weapons Arms Control," *Contemporary Security Policy* 17, no. 1 (April 1996): 1-79; Milton Leitenberg, "The Conversion of Biological Warfare Research and Development Facilities to Peaceful Uses," in *Control of Dual-Threat Agents: The Vaccines for Peace Programme*, ed. Erhard Geissler and John P. Woodall, *SIPRI Chemical & Biological Warfare Studies* No. 15 (Oxford: Oxford University Press, 1994), pp. 77-105; Tom Mangold and Jeff Goldberg, *Plague Wars: A True Story of Biological Warfare* (New York: St. Martin's Press, 1999); Rimmington, "Invisible Weapons of Mass Destruction."

and the existing proliferation threats.[17] These studies have primarily focused on aspects of the former Soviet BW complex from a macro perspective, to include overviews of the effectiveness of U.S. nonproliferation assistance.

The literature, however, lacks a detailed look at particular institutes as case studies to evaluate specific factors influencing conversion and proliferation threats. The BW institutes within Russia and the New Independent States operate in local environments that are still in flux as these countries adapt to new political and economic situations. These environments differ in each country. From studies of the former Soviet nuclear and chemical weapons complexes it is known that the interplay of technical, political, social, and economic influences in the local environment creates unique conditions affecting conversion and nonproliferation.[18] To date, no studies have conducted a detailed investigation of these influences on specific Soviet BW facilities. Identifying and understanding these influences is crucial to crafting and implementing appropriate and effective policy responses towards these facilities. Furthermore, because international assistance to these facilities is relatively recent, few studies have followed the process of policy implementation to analyze the extent to which these policies have been effective in the local environments, both from economic and nonproliferation perspectives.

To fill this gap in the literature and create a better understanding of the situation facing former Soviet BW facilities, we have undertaken a study of conversion efforts at the Scientific and Experimental Production Base in Stepnogorsk, Kazakhstan. Our decision to study this facility stems from the fact that: (1) it was one of the largest and most important BW production

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[17] Bozheyeva et al., *Former Soviet Biological Weapons Facilities in Kazakhstan*; Milton Leitenberg, "The Possibilities and Limitations of Biological Weapons Conversion: Personnel and Facilities," in *Conversion of Former BTW Facilities: Development & Production of Prophylactic, Diagnostic & Therapeutic Measures for Countering Diseases*, ed. Erhard Geissler, Lajos Gazsó, and Ernst Buder (Dordrecht: Kluwer, 1998), pp. 119-33; Judith Miller, Stephen Engelberg, and William Broad, *Germs: Biological Weapons and America's Secret War* (Simon & Schuster, 2001); Anthony Rimmington, "From Military to Industrial Complex? The Conversion of Biological Weapons Facilities in the Russian Federation," *Contemporary Security Policy* 17, no. 1 (April 1996): 80-112; Anthony Rimmington, "Fragmentation and Proliferation? The Fate of the Soviet Union's Offensive Biological Weapons Programme," *Contemporary Security Policy* 20, no. 1 (April 1999): 86-110; Anthony Rimmington, "Conversion of BW Facilities in Kazakhstan," in *Conversion of Former BTW Facilities*, pp. 167-86; Amy L. Stimson, *Toxic Archipelago: Preventing Proliferation from the Former Soviet Chemical and Biological Weapons Complexes*, Report No. 32 (Washington, DC: Henry L. Stimson Center, 1999).

[18] Vlad E. Genin, ed., *The Anatomy of Russian Defense Conversion* (Walnut Creek: Vega Press, 2001); Kimberly Marten Zisk, *Weapons, Culture, and Self-Interest: Soviet Defense Managers in the New Russia* (New York: Columbia University Press, 1997); Sonia Ben Ouagrham, "Conversion of Russian Chemical Weapons Production Facilities: Conflicts with the CWC," *Nonproliferation Review* 7, no. 2 (Summer 2000): 44-62.

facilities in the Soviet Union; (2) the Kazakh government has renounced its need to retain a biological weapons capability and has opened this facility to the international community; and (3) significant redirection and conversion efforts have been initiated under the support of the Kazakh and U.S. governments to address the economic and proliferation concerns at this facility. These conditions provide an opportune research setting for in-depth study and analysis.

In this study we will evaluate the Stepnogorsk facility from a number of perspectives: (1) historical context of the facility; (2) how the facility fits into the new Kazakh political environment; (3) past efforts to convert the facility and its people to peaceful work; (4) current status of scientists and research activities; (5) proliferation concerns involving technology and expertise; (6) role of U.S./international assistance in promoting conversion and nonproliferation; and (7) future prospects of the facility. Questions that are raised and discussed in this study include: What are the economic difficulties faced by the facility? What are the economic, political, social and other environmental factors that present obstacles or challenges to its conversion? How do internal and external politics, both in the United States and Kazakhstan, affect conversion efforts on the ground? What are plausible alternative economic activities for this facility? What are the specific proliferation concerns at Stepnogorsk? What are the proliferation implications of a failed conversion? Part of this work will also put the conversion of the Stepnogorsk facility into a larger context. What lessons are specific to our case and what can be applied to future conversion efforts at other former Soviet BW facilities? How important is the subject of conversion in addressing key U.S. and international security concerns?

This study has relied on open source material, as well as extensive interviews in Kazakhstan and the United States. We have spoken with scientists and officials from the Stepnogorsk facility and Kazakh government. In addition, a series of interviews were conducted with key American private sector representatives and U.S. government officials involved in converting and redirecting the facility. U.S. government officials greatly assisted in facilitating several interviews both in the United States and Kazakhstan, allowing us to participate in official U.S. government visits to Stepnogorsk, and inviting us to U.S. sponsored conferences and meetings both in the U.S. and Kazakhstan.

In the following pages, we show that, owing to the special characteristics and local environment in Stepnogorsk, conversion will be an important instrument to deal with the long-term "brain drain" proliferation threat from the bioweaponeers that remain. The arguments for this conclusion are presented in four sections. The first section provides background information on conversion involving past offensive BW facilities in other countries. The second section introduces the Biomedpreparat facility that we are using as a case study, and provides details on its historical context during the Soviet period. We then describe the restructuring and conversion efforts undertaken at the former BW facility by the new Kazakh government after the break up of the USSR. The failure of these early efforts to convert the facility, along with the awareness of the proliferation threats from its sensitive BW technology and expertise, brought U.S. and international attention to the facility in the mid-1990s. In this section, we also describe the role and effectiveness of this international assistance in addressing the security concerns and subsequent conversion attempts. The third section outlines other important external factors influencing the long-term economic sustainability of the facility and its weapons scientists and discuss appropriate future strategies for conversion at Stepnogorsk. In the final section, we take a step back to look at the larger picture of conversion in Soviet BW facilities. Based on our research findings, we suggest specific policy recommendations for the future role of U.S. and international assistance for conversion efforts at these facilities.

II. A COMPARATIVE FRAMEWORK

Before analyzing conversion at the SNOPB facility in Kazakhstan, we must first discuss general principles and concepts that underlie conversion of biological weapons facilities. Due to the growing influence of biotechnology in science and worldwide commerce, as well as its dual-use nature, many would argue that it should be easier to convert Soviet BW facilities than their nuclear or chemical counterparts. The information we present in the following pages, however, illustrates the contrary—converting BW facilities presents unique problems and is likely to be as difficult, if not more difficult in some cases, than converting other defense facilities. This will be illustrated by examining the historical record regarding conversion of former offensive BW facilities in other countries. For those interested in more detail regarding defense conversion, as well as some specificities related to former BW facilities and a Soviet context, we have included a section in the Appendix describing various economic, political, and technical issues.

A. Historical Precedents

The historical record documents few examples of successful commercial conversion involving BW facilities. To date, most of these examples have occurred under a political decision made by a government to end its offensive BW program. It is useful to briefly examine the conversion experiences of other state BW production and research facilities and determine whether they can serve as models for conversion in the former Soviet Union. Unfortunately, there is a dearth of information on former BW facilities in non-Western countries. Therefore, the following information will be based on British, German, and U.S. examples and used to discuss some general observations in converting former BW facilities. These examples will also be very helpful in highlighting the peculiarities of converting former BW facilities in the Former Soviet Union, particularly in Kazakhstan.

In the United States, one of the earliest BW conversion projects occurred soon after WWII. The Vigo pilot BW production facility was initially constructed to produce large scale weaponized anthrax and other agents. However, problems with the facility prevented it from ever producing BW agents. After the war, the American pharmaceutical company, Pfizer, Inc. took a lease on the plant in order to produce veterinary grade antibiotics. The plant is now owned and operated by Pfizer and still uses the original 20,000-gallon fermentation tanks to produce some of these antibiotics.[19]

When the U.S. government unilaterally ended its BW program in 1969, plans were made early on for conversion of Fort Detrick and the Pine Bluff Arsenal. Conversion at Pine Bluff proceeded relatively smoothly because the U.S. Food and Drug Administration (FDA) had selected the facility as the location for its proposed national center for food and drug safety evaluation. The FDA utilized most of the buildings and virtually all of the former scientific and labor personnel in the new Center. In spite of this, a 1972 GAO report found that new research funding to convert the Pine Bluff facility into the National Center for Toxicological Research would cost

[19] Edward Regis, *The Biology of Doom: The History of America's Secret Germ Warfare Project* (New York: Henry Holt & Co., 1999), p. 224.

approximately $8 million; demilitarization would cost an additional $10 million.[20] Conversion of the Pine Bluff plant was completed by summer 1972.

Conversion at the Fort Detrick facility was more problematic. Some difficulties that were encountered involved: (1) the size of the research facility and its work force; (2) the problem of finding an agency willing to assume responsibilities as landlord for the facility; (3) lack of firm plans and available funds by prospective users; (4) historical association with warfare research activity; and (5) concern that the buildings would require substantial repair to bring them up to standard.[21] In comparing the Fort Detrick and Pine Bluff facilities, the degree of success of these conversions was dependent to a large extent on whether firm operating plans for the facility had been developed by the prospective user.[22] In spite of the initial difficulties, Fort Detrick was eventually converted. Conversion was accomplished by dividing the facility into different components and relocating various personnel to other sites.[23] For example, approximately 20 percent of the former personnel at Fort Detrick were relocated to either biodefense related programs at the Dugway Proving Grounds in Utah or the Edgewood Arsenal in Maryland. Other personnel, equipment, and facilities dealing with plant sciences were transferred to the U.S. Department of Agriculture to work on defensive research against crop diseases. The largest portion of personnel and equipment were transferred to the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) at Fort Detrick. This institute was tasked with work on biodefense and civilian research to develop medical treatments for a variety of infectious diseases. Finally, a branch of the U.S. National Cancer Institute was established at Fort Detrick, which employed 200 weapons personnel and used former laboratory space and equipment to conduct nondefense related cancer research.

By comparison, smaller BW conversion projects were initiated in Britain and Germany. By the 1970s, Britain's Microbiological Research Establishment (MRE) had already expanded

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[20] Regis, *The Biology of Doom*, p. 213; U.S. General Accounting Office, *Report to Congress, Problems Associated with Converting Defense Research Facilities to Meet Different Needs: The Case of Ft. Detrick*, #B-160140 (Washington, DC: U.S. General Accounting Office, 16 February 1972): 11.

[21] U.S. General Accounting Office, *Problems Associated with Converting Defense Facilities*, p. 15-20.

[22] Ibid., p. 19

[23] Milton Leitenberg, "Conversion of BW R&D Facilities," in *Control of Dual Threat Agents: The Vaccines for Peace Programme*, ed. Erhard Geissler and John P. Woodall (Oxford: Oxford University Press, 1994), pp. 86-87.

its activities from purely biodefense research to work on civilian public health issues.[24] For example, a center for arbovirus research was established, and gradually more work at MRE involved fundamental research with civilian applications not aimed at biodefense. After WWII, Germany's largest dual-use BW facility, the State Research Institute Insel Riems, was totally dismantled.[25] In 1946, however, the Soviet Military Administration in Germany issued an order to reconstruct the facility to provide vaccines and antibodies to treat infectious animal diseases. This new work at the Riems facility was an extension of the former civilian R&D and production that had been carried out in parallel with prior wartime activities.

These conversion examples reveal interesting elements that will be helpful in determining whether previous experiences can serve as models for conversion in the former Soviet Union. One of the common points of these experiences is that conversion was generated by a state decision caused by strategic changes: the renouncement of BW use in the United States and Great Britain, the end of the war in Germany. Conversion was also initiated and conducted by state authorities, with significant government resources and support invested in these programs.[26] Except for the Vigo plant, which was leased by a private company, these facilities remained under the control of the state and their new activities were determined by the state.

In most of the cases, conversion was not conducted by the previous managers of the facility. Instead, an outside agent—be it a government agency or a private contractor—conducted the conversion of the facility. For instance, in the United States, the Fort Detrick facility was operated by a private contractor but remained state-owned. In Germany, the Insel Reims facility was reconstructed and supported by the Soviet government.

Another important characteristic is that demilitarization, (decrease or end of defense activities), demobilization (destruction of excess military resources), and restructuring (modernization of equipment and buildings, hiring of new personnel) preceded the conversion process itself. From this point of view, the Fort Detrick example is very enlightening. Soon after the

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[24] Graham S. Pearson, "Conversion of Past Biological Weapons Facilities: Lessons from Western Conversion," in *Conversion of Former BTW Facilities*, pp. 76-77; Gordon B. Carter, *Porton Down: 75 Years of Chemical and Biological Research* (London: HMSO, 1992), pp. 76-79.

[25] Erhard Geissler, "Conversion of BTW Facilities: Lessons from German History," in *Conversion of Former BTW Facilities*, pp. 61-62.

[26] Graham S. Pearson, "Conversion of Past Biological Weapons Facilities," pp. 73-83.

decision to convert the facility, the military personnel were relocated to other facilities, part of the civilian personnel were fired, the equipment and buildings were modernized, new agencies settled in the emptied buildings, and the new contractor was provided with a clear list of the resources available for conversion.[27] Finally, apart from Vigo, none of these facilities was expected to become profitable or operate as a commercial enterprise. We must remember also that in most of the cases presented above, conversion occurred during relatively stable economic periods and happened relatively quickly.

B. Are Western Conversion Models Appropriate for BW Facilities in the Former Soviet Union?

Similar to what occurred in western countries, conversion of BW facilities in the Former Soviet Union was triggered by a political decision to stop national offensive BW programs. In 1992, President Yeltsin reiterated Russia's commitment to the Biological and Toxin Weapons Convention (BTWC) and stopped lingering offensive activities.[28] In Kazakhstan, there has been no official declaration specifically mentioning the BW program.[29] Nevertheless, Kazakhstan's President Nazerbaev has clearly stated his country's intention to eliminate the Soviet offensive BW legacy within its borders. Since the break-up of the USSR, some of these facilities have remained as state-owned facilities. Other facilities have been transformed into joint stock companies, but even in this case, the State remains the only or major shareholder.

Contrary to western examples, conversion in the former Soviet Union typically has been conducted by the former Soviet management team. These teams are generally composed of military personnel, who have little market experience. They have not benefitted from the guidance of an outside agent, such as a private contractor, who understands the principles of a market econ-

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[27] "President Prodded on Ft. Detrick," *Washington Post*, 10 July 1971, pp. E1-3; Harold M. Schmeck, Jr., "Litton to Run Cancer Research Lab," *New York Times*, 25 June 1972, p. 24.

[28] In spite of these declarations there remain concerns within the international community regarding Russia's compliance with the BTWC. "Decree of the President of the Russian Federation on Fulfilling International Obligations with Regard to Biological Weapons," 11 April 1992; "Joint Statement on Biological Weapons by the Governments of the United Kingdom, the United States, and the Russian Federation," 10-11 September 1992, at http://www.stimson.org/cbw/?sn=CB20011221162, accessed 11 July 2002.

[29] Recently, the U.S. and British governments are putting pressure on Kazakhstan to join the BTWC. See "Kazakhstan: U.S., Britain Want Kazakhstan to Join the Biological Weapons Convention," Almaty Kazakh Commercial TV (in Russian), 10 July 2002.

omy. Also, they have to convert in an environment where market institutions (a sound banking system, clear and applicable rules, developed communication and transportation systems, to name a few) are underdeveloped or non-existent. On top of this, conversion has also been launched without a prior restructuring; it has to take place without state support or involvement, and all converting facilities have been required to start operating as commercial enterprises. These are obstacles difficult to overcome, more particularly for former BW facilities, which unlike nuclear and chemical facilities cannot re-use their equipment and buildings due to the risks of contamination.

Finally, conversion in the former Soviet Union has been launched before a proper demilitarization. This implies that these facilities still house resources that can be used for military purposes (BW-specific equipment, personnel, material). In the absence of State support, a failed conversion may lead to increased proliferation risks. To illustrate this, we will use as a case study the former BW production facility in Stepnogorsk, Kazakhstan.

III. SNOPB AND BIOMEDPREPARAT: A UNIQUE CASE STUDY

As described above, because there are virtually no historical examples of conversion of biological facilities, we are left with a poor understanding of what is involved. The BW facilities left behind from the legacy of the former Soviet BW program provide one of the most interesting opportunities to examine conversion from a first-hand perspective. There is no way to accurately predict the future outcome of these on-going conversion efforts. Yet, examining how conversion has been implemented and how it is progressing in the former Soviet Union can shed light on the challenges, requirements, and prospects of converting BW facilities in unstable political and economic settings.

In the following pages, we will describe the conversion of the Scientific and Experimental Production Base (SNOPB), Biomedpreparat, and the National Center of Biotechnology (NCB)—three important components of a major Soviet BW production facility in Stepnogorsk, Kazakhstan, which is currently attempting to convert to civilian production. To begin, we will provide the historical context of SNOPB by explaining the facility's relevance to the Soviet BW program. Next, we will track the facility's history and its resulting structural changes through the end of the Cold War to its present day situation. Part of this description will include a discussion of the first conversion attempt at Stepnogorsk in the mid 1990s—a conversion effort that failed miserably and subsequently led to plans for dismantlement of the facility. Within this context, we will focus our attention on the efforts made by the U.S. government to assist in the dismantlement effort, as well as redirect the remaining bioweaponeers to sustainable activities. To conclude, we will examine the current political, economic, and social climate surrounding the facility and how these factors have influenced prior and ongoing conversion efforts.

A. The Former Soviet BW Program: The Biopreparat Administration

The USSR's BW program involved an extensive number of research institutes, production facilities, and testing sites spread across Russia and several of the former Soviet republics.[30] Although dating back to the 1920s, the BW program was greatly expanded after the USSR signed and ratified the BTWC.[31] Starting in early 1970s, a number of new BW activities were initiated in civilian and military facilities under several Soviet government agencies to include the Ministries of Agriculture, Chemical Industry, Defense, Health, Microbiological Industries, the Academy of Sciences, and the KGB. Under Soviet military doctrine biological weapons were to be used as strategic, operational, and strategic-operational weapons.[32] Agents were developed against human, plant, and animal targets.

In 1973, within the Main Directorate of Microbiological Industry of the Soviet Council of Ministers (Glavmikrobioprom), a new directorate was established called the All-Union Science Production Association Biopreparat (Biopreparat).[33] Under this new directorate, a number of new R&D, production, and mobilization facilities for biological weapons were created. In the mid-1980s a government reorganization transferred Biopreparat to the Ministry of Medical and

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[30] It is difficult to say exactly how many total facilities were involved in the USSR's entire BW program due to the secrecy, compartmentalization, and dual-use nature of the program. Available information suggests approximately 40+ institutes, employing 60,000 total personnel across several different Soviet ministries, were involved in Soviet BW activities. It is important to emphasize, however, that the number of employees includes scientific personnel, as well as administrative and support staff. More detailed information regarding the former Soviet BW program can be found in Alibek and Handelman, *Biohazard*; Anthony Rimmington, "Invisible Weapons of Mass Destruction: The Soviet Union's BW Programme and its Implications for Contemporary Arms Control," *Journal of Slavic Military Studies* 13, no. 3 (September 2000): 23-28; Igor Domaradsky, "The History of One Risk Venture: Parts I and II," in *Znanie—Sila* (unpublished manuscripts, November-December 1996).

[31] Rimmington, "Invisible Weapons of Mass Destruction," pp. 23-28.

[32] Jonathan B. Tucker, "Biological Weapons in the Former Soviet Union," p. 2.

[33] Domaradskiy, "The History of One Risky Venture," p. 9; Rimmington, "Invisible Weapons of Mass Destruction," p. 9.

Microbiological Industries.[34] In spite of this administrative change, Biopreparat remained virtually independent and held major funding and management oversight of Soviet BW activities. At its peak, the Biopreparat complex consisted of 40 facilities, although not all of them were devoted to BW activities.[35] Approximately 30,000 total employees worked in the Biopreparat administration, of which about 10,000 had weapons-relevant skills, with approximately 5,000 having critical BW knowledge.[36] One of the most significant Biopreparat mobilization facilities was the Progress Scientific and Production Association.

B. Progress Scientific and Production Association: The NCB's Soviet Ancestor

As with many Soviet defense facilities, the Progress Scientific and Production Association (PSPA) was composed of civilian and military components (see Figure 2). The civilian part, Plant Progress, had two functions: (1) to produce pesticides for civilian use, and (2) to serve as a cover for the production of biological weapons taking place at the military component of PSPA. This military part was known as the Stepnogorsk Scientific Experimental and Production Base (SNOPB). SNOPB was established in 1982 by a secret edict from Communist Party Secretary General Brezhnev, in spite of the fact that the Soviet Union had signed and ratified the Biological and Toxin Weapons Convention in 1975. The facility was constructed in northern Kazakhstan in the closed city of Stepnogorsk, located approximately 200 kilometers from the present day capital of Astana.

Although the official establishment of SNOPB took place in 1982, plans to build the facility were already being developed in the 1960s. Originally, the facility was designed to be headed by one director, who would direct the civilian production in peacetime, and would organize the mobilization of the complex and the production of BW in wartime.[37] The civilian

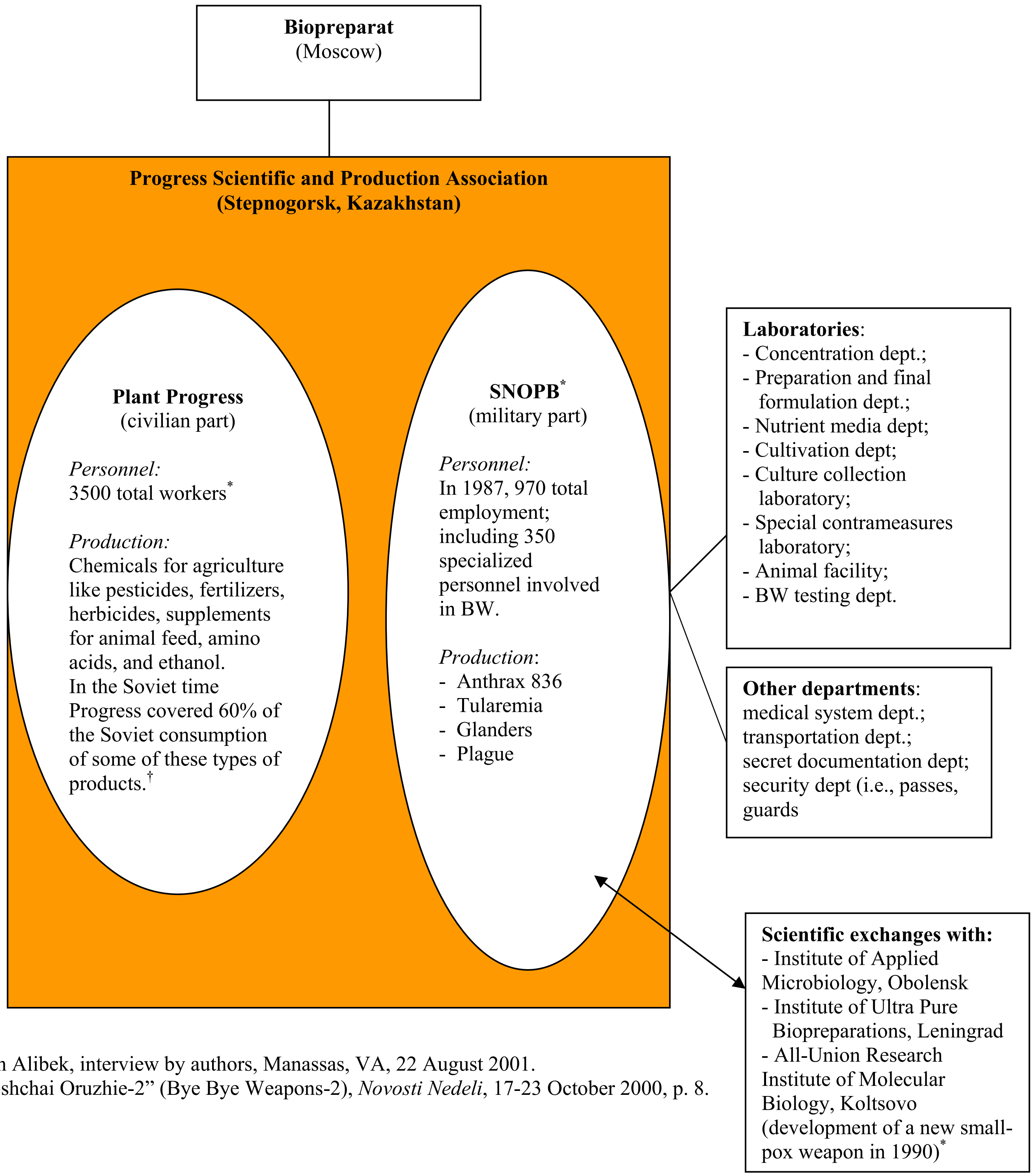
[34] Alibek and Handelman, *Biohazard*, p. 29.

[35] Some Biopreparat facilities did legitimate work on pharmaceuticals and vaccines. Tucker, "Biological Weapons in the Former Soviet Union," p. 4.

[36] U.S. General Accounting Office, *Biological Weapons*, p. 10.

[37] Ken Alibek, interview with authors, Manassas, VA, 22 August 2001.

FIGURE 2: STRUCTURAL ORGANIZATION OF SNOPB UP TO 1992



* Ken Alibek, interview by authors, Manassas, VA, 22 August 2001.
† Proshchai Oruzhie-2" (Bye Bye Weapons-2), *Novosti Nedeli*, 17-23 October 2000, p. 8.

part, a biopesticide production plant called Plant Progress, was built first.[38] This facility also controlled all utilities (i.e., energy systems, steam production, electricity, hot water) that would ultimately be used for BW production. The construction of the military side started in the second half of the 1970s. Strangely enough, the BW assembly lines, bunkers, and storage buildings were built first. This was followed by construction of the main BW production buildings—buildings 221 and 211.[39]

The construction of building 221 was still under way when a release of anthrax occurred at the offensive Ministry of Defense (MOD) BW facility at Sverdlovsk in 1979.[40] When the need arose to relocate BW production activities from Sverdlovsk, three facilities were considered: Kurgan, Penza, and Stepnogorsk. The Russian BW facilities located in Kurgan and Penza were already heavily involved in the production of antibiotics. In contrast, since the Stepnogorsk facility had not been finished, it was the only facility that did not have existing utilization plans. Therefore, the facility could be designed and modified to accommodate large scale BW production.[41] By 1982, a decision by the Soviet government had been made to adopt the existing fermentors in Stepnogorsk for manufacturing anthrax biological weapons.[42] Under the control of the USSR's Biopreparat administration, specialized equipment and personnel were transferred from

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[38] Progress was one of two principal producers of the *Bacillus thuringiensis*-based insecticides in the Soviet Union, as well as dendrobatsillin (based on *B. thuringiensis* variety dendrolinus), used in cotton crop protection, and bitoxybacillin (a bacterial pesticide based on *B. thuringiensis* variety *thuringiensis*). The bitoxybacillin was used to fight Colorado potato beetles attacking potato plants and silkworms. The bitoxybacillin was sold to collective and state farms, as well as to the general public. Anthony Rimmington with Rod Greenshields, *Technology and Transition: A Survey of Biotechnology in Russia, Ukraine, and the Baltic States* (Westport, CT: Quorum Books, 1992), pp. 15-16, 19.

[39] These buildings were completed in 1981.

[40] During the Soviet period, the Sverdlovsk BW facility was the USSR's main production facility for anthrax biological weapons. In 1979, an accidental release of anthrax bacteria from the facility killed at least 200 locals and brought international scrutiny to the facility, raising suspicions of continuing offensive BW activity in the USSR. See Matthew Meselson, Jeanne Guillemin, Martin Hugh-Jones, Alexander Langmuir, Ilona Popova, Alexi Shelokov, and Olga Yampolskaya, "The Sverdlovsk Anthrax Outbreak of 1979," *Science* 266 (18 November 1994): 1202-1208; and "The Accidental Explosion at a Secret Biological Weapons Plant at Sverdlovsk," Document compiled by U.S Air Force from classified U.S. Air Force Records, Unclassified, n.d. (ca. 9/80) p. 1 (Source: USAF FOIA; obtained at http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB61/).

[41] Ken Alibek, interview with authors, Manassas, VA, 22 August 2001.

[42] Building 221 was equipped with 20 m^3 fermentors that were originally designed to manufacture biological weapons with plague, tularemia and brucellosis bacteria. Subsequently, the production of tularemia was replaced by anthrax; brucellosis bacteria was replaced with glanders bacteria. Ken Alibek, interview with authors, Manassas, VA, 22 August 2001.

Sverdlovsk to SNOPB.[43] SNOPB was further expanded alongside Progress in order to utilize existing electrical power, heat, water, steam, and communication infrastructure.[44]

From then on, Plant Progress and SNOPB grew into separate entities, headed by two different directors, and having their own personnel. Although SNOPB was located within the same complex as Plant Progress, SNOPB was a restricted facility and required special security clearances to enter the site. Civilian personnel working at Plant Progress were informed neither of activities occurring within SNOPB, nor was the training that was given to them to work on SNOPB production lines in case of war explained.

When SNOPB was first opened, it faced two main objectives: (1) to improve the potency of the existing Soviet anthrax biological weapon, and (2) to increase the organizational capacity to manufacture anthrax biological weapons.[45] Both of these objectives encountered some obstacles. In order to improve the potency of the existing anthrax biological weapon, SNOPB first developed its research and experimental capabilities and created a small R&D unit. The unit was responsible for developing Anthrax 836, the USSR's strain of anthrax agent that was reproducible in large quantities, of high virulence, easy to transport, and resistant to a number of Western medical treatments.[46] Initially, however, SNOPB attempted to use a strain of anthrax developed by the Russian Ministry of Defense (MOD) for their BW production. The anthrax formulation developed by the MOD, however, had some limitations. The Q_{50} level for that anthrax strain was too high—approximately 16 kilos/km^2.[47] To improve the agent's effectiveness, the research team at Stepnogorsk developed a new formulation for an anthrax BW that eventually yielded a much lower Q_{50}.

In terms of organizational capacity, SNOPB was faced with the difficulty of increasing and testing its production capabilities in the context of a shortage of qualified labor and energy

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[43] Gennadiy Lepyoshkin, director of the NCB until April 2001, interview with authors, Washington, DC, February 2001.

[44] Ken Alibek, interview with authors, Manassas, VA, 22 August 2001.

[45] Eventually, SNOPB would produce anthrax at a 300 tons/year capability.

[46] Alibek and Handelman, *Biohazard*, p. 87.

[47] Q_{50} is the amount of BW agent necessary to cover 1 km^2 of territory. Ken Alibek, interview with authors, Manasses, VA, 22 August 2001.

sources. In 1983, the workforce at SNOPB consisted of 40 people, with only 4 or 5 engineers.[48] Kanatjan Alibekov was nominated at the head of the facility that same year in order to enlarge the facility's production capability.[49] By 1987, the facility had grown to 970 employees, approximately one-third of whom were BW specialists. This increase in qualified personnel was made possible, in part, by the relocation of about 65 military scientists from the Soviet MOD BW facilities located in Kirov and Sverdlovsk. These individuals held all of the managerial positions within SNOPB, such as deputy directors, department chiefs, laboratory heads, senior engineers, senior scientists. They also served as master trainers and provided the initial on-site scientific training, lasting 2-3 months, to all new BW technical recruits. To maintain the separation between SNOPB and Progress, Alibekov was instructed not to hire personnel from Plant Progress but from a nearby uranium processing mine that was in the process of decreasing its activities. Frequent scientific collaborations and exchanges between SNOPB scientists and other BW scientists from Russian facilities in Obolensk and Leningrad (now St. Petersburg) also took place during this time, and allowed expansion of the scientific capabilities of the facility and improvement of biological agent formulations.[50]

SNOPB covered a large complex, spanning about two square kilometers, including several large buildings and support structures. Such an industrial structure required large amounts of electricity to conduct equipment tests as well as production. Unfortunately, the utilities infrastructure was not sufficient to cover the needs of both Plant Progress and SNOPB. As the original plan was to create a dual-purpose facility, there were no plans to build separate energy supplies for SNOPB. In wartime, Progress was to be subordinate to SNOPB and stop all civilian production, as well as provide the additional workforce to ramp up the military production capacity. In peacetime however, SNOPB was subordinate to Progress, as the civilian facility had to complete its own production plan. However, as the facilities grew as separate entities with different objectives and competing production plans, the competition for resources became a point of conflict between the two managers. More particularly, energy use was the source of

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[48] Ken Alibek, interview by authors, Manassas, VA, 22 August 2001.

[49] As the SNOPB already had a Director at the time, Alibekov was nominated deputy director by the Soviet Biopreparat administration. It was planned that he would ultimately replace the existing director as the head of SNOPB. Note to readers: after his 1992 defection to the United States, Kanatjan Alibekov changed his name to Ken Alibek.

[50] Ken Alibek, interview by authors, Manassas, VA, 22 August 2001.

constant battles between the management of SNOPB and Progress. For instance, during BW production trials, SNOPB was allowed to use no more than 20 percent of the entire facility's energy capabilities. The testing of four 20-m^3 reactors simultaneously was also prohibited by Progress' director due to the large-scale energy use it would require.[51]

From 1987, activity and personnel at SNOPB began to decline. One of the main reasons was that the facility completed its R&D and scale-up work with the anthrax biological weapon. SNOPB later started working with glanders and tested Marburg weapons, but no production was involved. In the late 1980s, there was also a concern that Gorbachev would want to open some BW facilities for visits by international authorities for confidence building activities under the Biological and Toxin Weapons Convention. Because of this, SNOPB undertook plans for decontamination and "conversion." For example, SNOPB worked on developing a commercial antibiotic called roseofungin and other biodefense treatments. However, these "conversion" plans were only designed to serve as a cover for the BW production activities.[52]

In 1991, Kazakhstan became an independent country. SNOPB, however, remained under the administrative subordination of Biopreparat in Moscow until 1992. After the break-up of the USSR, SNOPB's secret BW-related documents were taken back to Russia.[53] As the facility primarily employed ethnic Russians, approximately 70-90 percent of the personnel left Stepnogorsk in several waves. It is believed that most of them returned to Russia to work at the Sverdlovsk facility, other Biopreparat facilities, universities, or commercial biotechnology companies. Some of these individuals subsequently returned to Stepnogorsk if they could not find work or adapt to the New Russia.

SNOPB's management had initially planned to maintain its subordination to the Russian Biopreparat agency and operate the facility for the Russian government from the Kazakh territory. However, after financial support from Moscow ended in 1992, Gennady Lepyoshkin, who had succeeded Alibekov as the head of the facility, held negotiations with President Nazerbaev to transfer the facility to the control of the Kazakh government. By 1993, Stepnogorsk was under the full control and oversight of the Kazakh government.

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[51] Ibid.

[52] Ibid.

[53] Gennady Lepyoshkin, interview by authors, Washington, DC, February 2001.

C. New Beginnings: National Center of Biotechnology (NCB)

In 1993, the new Kazakh government made plans to reorganize the state's BW facilities. All former BW facilities based in Kazakhstan, previously falling under the Soviet Biopreparat administration and the Soviet Ministry of Agriculture, were merged with other civilian microbiology facilities formerly under the control of the Kazakh branch of the Soviet Academy of Sciences. The result of this reorganization was the creation of the National Center for Biotechnology (NCB) of the Republic of Kazakhstan, founded by Presidential Edict on 21 January 1993.[54] The purpose of this reorganization was to create a center of excellence in the biotechnology field and to exploit the technological advances of the former military facilities to meet national needs in medicine, agriculture and industry. This decision was also triggered by the short-lived and unsuccessful attempts by the Kazakh Ministries of Health and Agriculture to convert former Soviet BW facilities located in Kazakhstan during the course of 1992.[55] Since its inception, the NCB has known many changes in its membership and administrative structure due to numerous government reshufflings, but the SNOPB (now called Biomedpreparat) remains to this day the leading component of the NCB.

1. The NCB Administration: 1993-1999

When it was created in 1993, the NCB included eight organizations located in various cities of Kazakhstan, four of which were former BW facilities (see Figure 3). Among them was SNOPB, which was transformed into a Joint-Stock Company and renamed Biomedpreparat in 1993. The second former BW member of the NCB is the Scientific Research Agricultural Institute (SRAI), located in Otar. SRAI formerly fell under the authority of the Soviet Ministry of Agriculture. Its contribution to the Soviet BW program involved studying exotic and infectious plant and animal diseases. The third former BW facility, Biokombinat, is an Almaty-based mobilization facility capable of producing animal vaccines and diagnostics for infectious animal diseases. It was also formerly under the authority of the Soviet Ministry of Agriculture.[56] In

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[54] Bozheyeva et al., *Former Soviet Biological Weapons Facilities in Kazakhstan*, p. 18.

[55] Ibid., p. 17.

[56] Ibid., p. 18.

1993, a new entity was created, the Institute of Pharmaceutical Biotechnology (IPB), which consisted of equipment and personnel originating from Biomedpreparat.

The other four original members of the NCB were civilian facilities. In addition to Plant Progress, which was also transformed into a joint stock company in 1993, the civilian members of NCB included the Institute of Medico-biology based in Stepnogorsk, as well as the Institute of Molecular Biology and Biochemistry, and the Institute of Plant Physiology, Genetics and Bio-engineering (IPPGB), both located in Almaty. The latter two institutes had been under the control of the Kazakh branch of the Soviet Academy of Sciences during the Soviet era.

Between 1993 and 1999, several waves of reorganization occurred, resulting in the modification of NCB's membership. In particular, three of the Center's original members left the NCB. The Institute of Molecular Biology and Biochemistry became an independent entity. The Institute of Medico-biology was transferred to the Medical Academy of the Akmola region (under the Ministry of Health).[57] Finally, in 1997, by government decision, Plant Progress was divided into six smaller production and research entities and privatized.[58]

Two new entities were also created within the Center. In 1998, the Environment Monitoring Laboratory was created within Biomedpreparat with the financial support of the U.S. Department of Defense. Also, a small enterprise named Aspect-pharm was created within the IPB to produce and market civilian products (see Figure 4).

2. The NCB Today

In 2000, the NCB consisted of six main organizations with two dependent entities under the oversight of a management entity, also called the NCB (see Figure 4). In 2001, a new reorganization of the Center occurred which resulted in the transfer of the Central Laboratory of Medi-

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[57] Gennady Lepyoshkin, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

[58] These entities were: Lizin, Gerbitsid, Transport, Aminokisloty, Biomedpreparat (different from SNOPB), and Progress-Dubl 3. Ultimately, most of these facilities went bankrupt, closed, or simply disappeared for unknown reasons. Those which still operate to this day are: (1) the electricity production and distribution facility (providing electricity to the NCB), (2) the small enterprise "Biomedpreparat," which produces industrial alcohol, and (3) Transport, the road transportation enterprise that operates within and beyond Stepnogorsk. See "Proshchai Oruzhie-2," *Novosti Nedeli*, 17-23 October 2000, p. 8. Gennady Lepyoshkin, interview by authors, Stepnogorsk, Kazakhstan, April 2000 and Washington, DC, February 2001.

FIGURE 3: STRUCTURAL ORGANIZATION OF THE NCB FROM 1993 TO 1999

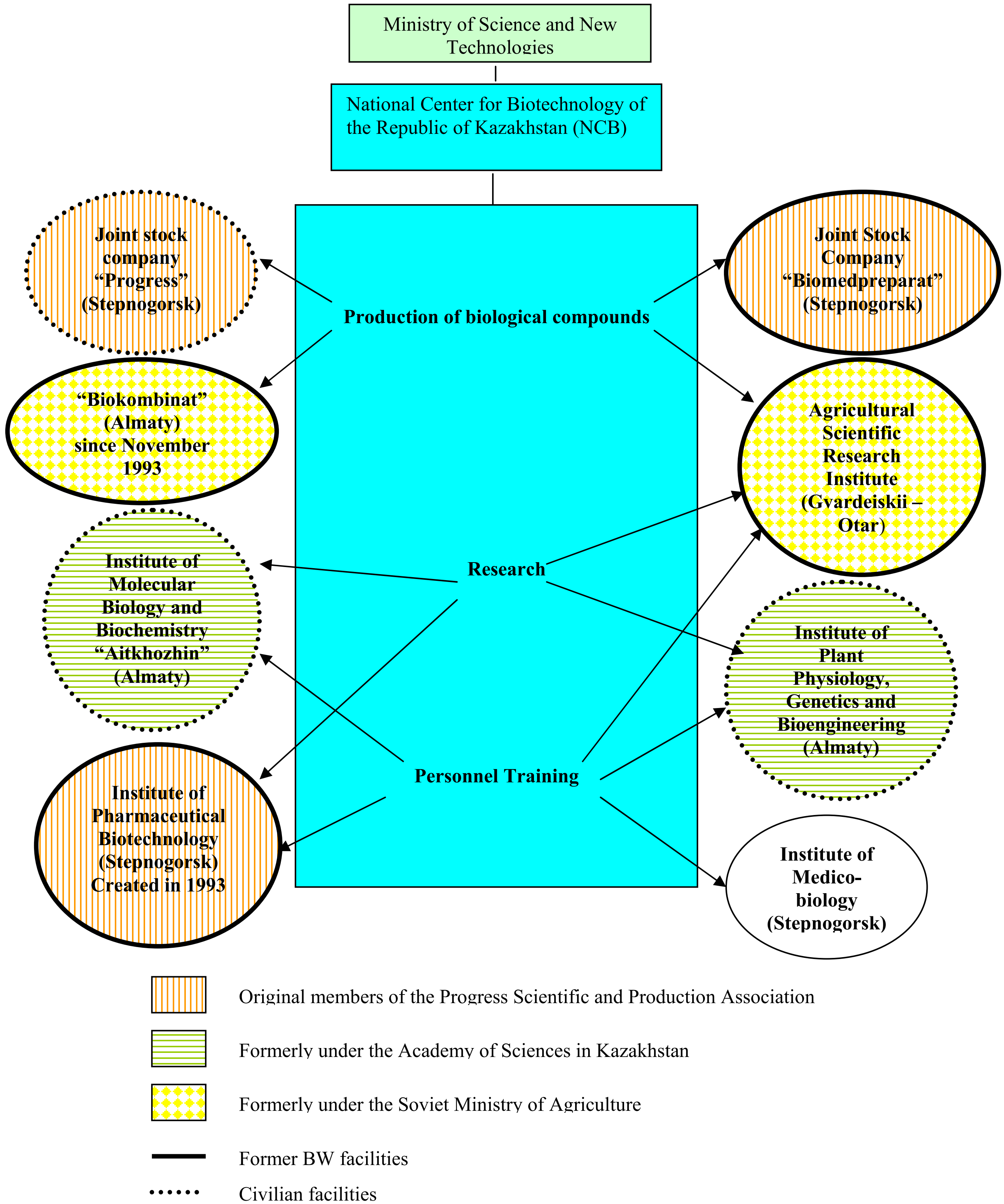
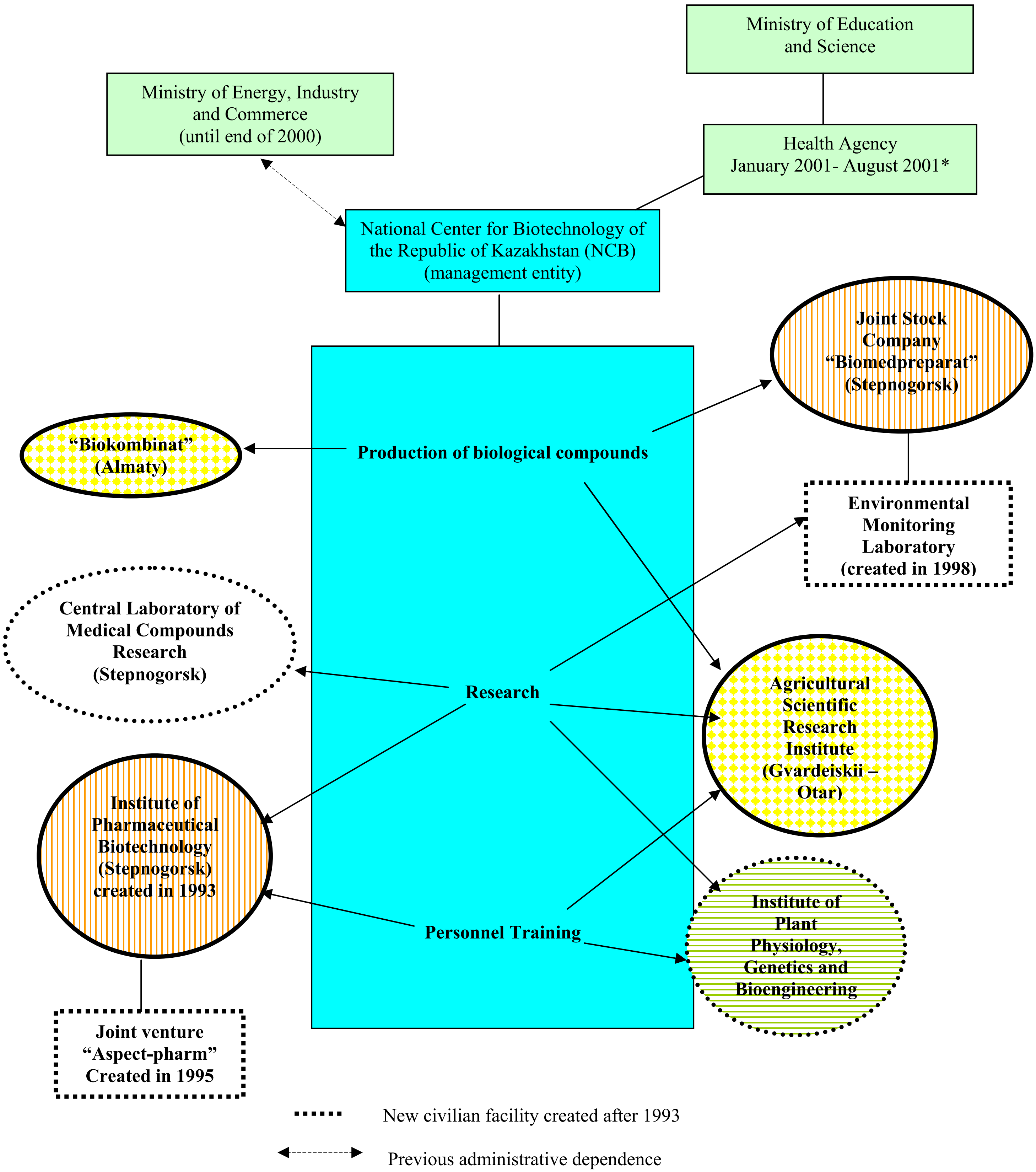


FIGURE 4: STRUCTURAL ORGANIZATION OF THE NCB IN 2000



*The Health Agency was eliminated in September 2001, to be replaced by the newly created Ministry of Health. The NCB however remains under the authority of the Ministry of Education and Science.

cal Compounds Research (CLMCR) to the Medical Academy in Astana (Kazakhstan's new capital).[59] Thus the NCB is now composed of five main organizations and two dependent entities (see Figure 5). Formally, the NCB operates as a consortium, with each member organization having its own activities, budget, and management team.[60] The NCB members, however, are tied together, by the implementation of state programs, such as the program on, "The Use of Genetics for Agriculture, Health and Industry." Total employment at the NCB is now approximately 1000 employees distributed among its member organizations in Stepnogorsk, Almaty, and Otar.[61]

Within Stepnogorsk, the following facilities are found:

- The NCB: The NCB is the management oversight entity, composed of 50 administrative employees, including the General Director of the NCB.[62] The NCB has the following functions: (1) to determine priorities and coordinate the activities of its members; (2) to implement physical and chemical biological research programs; (3) to develop new technologies, monitor imports, and increase export potential; (4) to redirect the activities of its members towards civilian purposes, and more particularly towards the development of research and production of biological compounds for drugs, food, and pesticides production among other things; (5) to monitor the consequences of its members' activities on the environment; and (6) to implement international cooperation and research exchanges in the field of biotechnology.
- AO Biomedpreparat: AO Biomedpreparat is the former BW production facility (SNOPB). Today it has no other activity but the dismantlement of the BW production equipment and infrastructure, funded by U.S. government assistance. Biomedpreparat presently employs 120 personnel in total, which includes all scientific, administrative, and support personnel.
- The Environment Monitoring Laboratory: The Environment Monitoring Laboratory was created in March 1998 within AO Biomedpreparat. It has 30 employees, including its director.[63] The Laboratory has state of the art equipment provided under U.S. government assistance. It can perform biochemical, biophysical and microbiological analyses. The main tasks of the monitoring laboratory today are: (1) testing of contamination levels during execution of the dismantlement contract, (2) testing and ecological monitoring of biochemical and chemical contamination in the regions of Kazakhstan from industrial

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[59] In order to promote the replacement of imported drugs by locally produced drugs, the CLMCR concentrates on the development and clinical testing of medical compounds and authorizes their production.

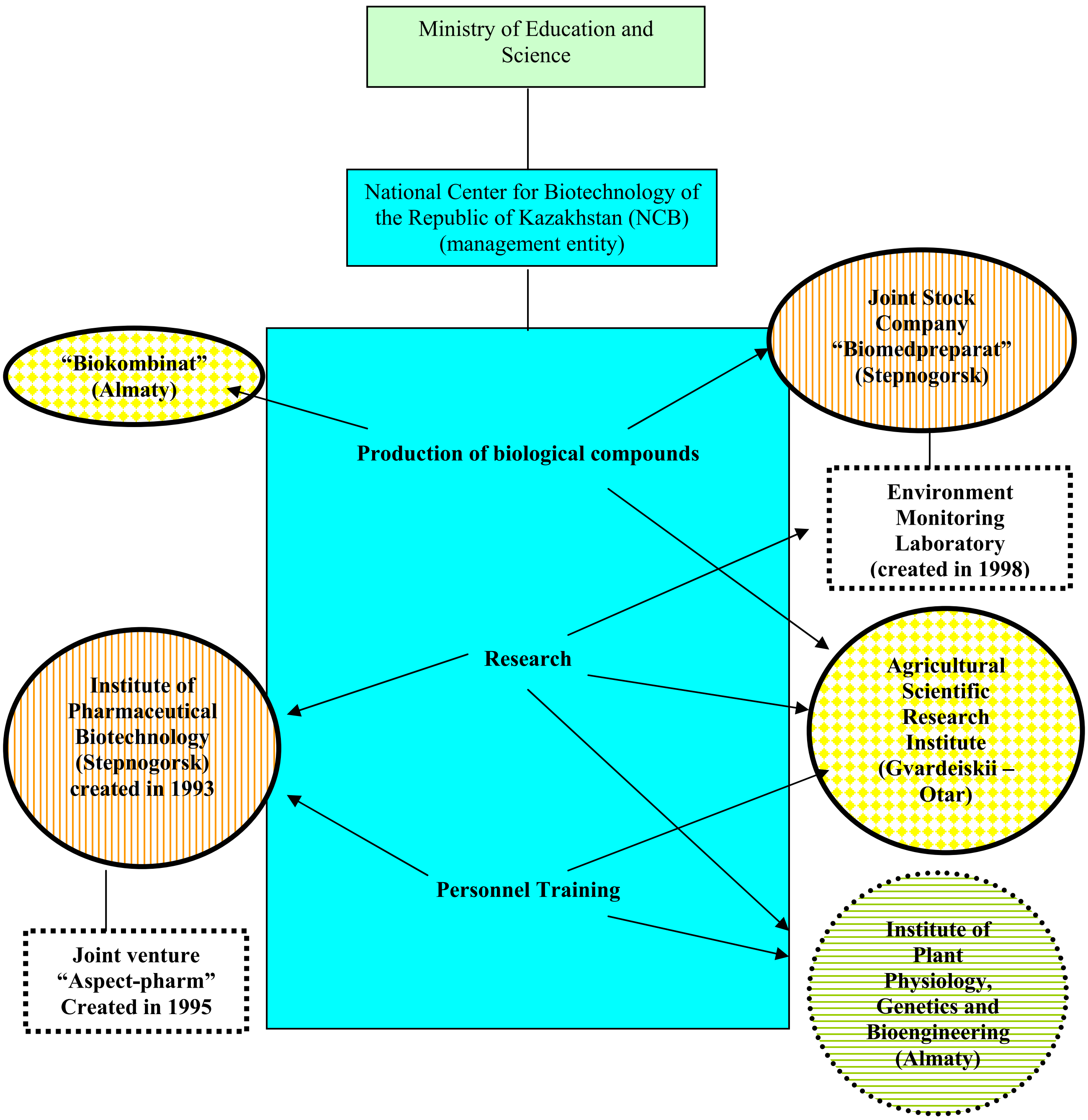
[60] Gennady Lepyoshkin, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

[61] Gennady Lepyoshkin, interview by authors, Washington, DC, February 2001.

[62] Dr. Gennady Lepyoshkin was General Director of the NCB from 1993 to March 2001. Since April 2001, this function has been assumed by Dr. Serghazy Adikenov.

[63] In April 2001, the director of the Environmental Monitoring Laboratory, Dr. Alexander Kossinov, was demoted to the position of Deputy-Director.

FIGURE 5: STRUCTURAL ORGANIZATION OF THE NCB IN 2001



and former weapons facilities. In the future, the NCB plans to develop the Laboratory to serve as a regional environmental monitoring center in Central Asia.

- <u>The Institute of Pharmaceutical Biotechnology (IPB):</u> The IPB was created in 1993 and located in a remodeled building that used to house a kindergarten in downtown Stepnogorsk (off-site of the weapons complex). Its has 70 employees, including its director.[64] The technical staff working at the institute previously worked on the production and fermentation of biological agents in building 221 at SNOPB.[65] The IPB also inherited part of its laboratory equipment, such as fermentors of U.S., Japanese and European origin from the SNOPB. The Institute includes three laboratories: (1) the microbiology synthesis lab, which conducts basic research and maintains the Institute's collection of industrial bacteria; (2) the applied biotechnology laboratory, which develops drugs for diseases of microbial, vegetal, and animal origin; and (3) the physical biochemistry laboratory which performs pre-clinical testing of drugs. The IPB houses a museum of over 130 industrial cultures of bacteria and fungi, and genetically modified strains for industrial production of microbiological products. The IPB also has a small production facility for drugs, diagnostics, and prophylactic compounds, as well as other biochemical and immuno-chemical reagents.[66]
- <u>Aspect-pharm:</u> In 1995, the IPB created a small joint venture called "Aspect-pharm." Ninety percent of this small business' staff is composed of former employees of Biomedpreparat and Progress. This pharmaceutical enterprise produces most of the new civilian products developed at the IPB. This includes medicinal herb tonics like "Ovsa," "Stevia," a sugar substitute, antibiotics like "roseofungin," and food bacteria like "bifidumbacteria" and "lactobacteria." This venture was established mostly to facilitate and accelerate cooperation between the IPB and foreign enterprises. Since state enterprises, like the IPB, have too many administrative constraints, foreign investors usually prefer cooperating with private smaller businesses. Eighty percent of Aspect-pharm shares are owned by private investors, and only 20 percent of its shares are state-owned.[67]

The other members of the NCB are located outside Stepnogorsk: two are in Almaty, and one is in Otar:

- <u>The Scientific Research Agricultural Institute (SRAI):</u> The Scientific Research Agricultural Institute is located in the city of Otar, about 200 km west of Almaty, on a Kazakh military base. Currently employing 250 people, SRAI specializes in the study of exotic foreign plant and animal diseases. In addition to research, one of the main activities of

[64] In April 2001, Dr. Vladimir Bugreev, director of the IPB, was fired due to a Kazakh government reorganization.

[65] Vladimir Bugreev, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

[66] Vladimir Bugreev, presentation given at conference, "Former Biological Weapon Facilities: Dismantlement and Prospects for Conversion, Stepnogorsk, Kazakhstan, 24 July 2000.

[67] Vladimir Bugreev, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

the Institute is to produce animal vaccines and diagnostics.[68] These products are sold in Kazakhstan, Kyrgyzstan, and Uzbekistan. The institute houses a collection of viral animal diseases that includes 11 highly dangerous and exotic strains of animal diseases. SRAI also houses a collection of plant pathogens, and conducts research on the development of disease-resistant plants.

- Biokombinat: Biokombinat is a 30,000 m^2 production facility, located in Almaty. It specializes in the production of 35 types of animal vaccines (such as a veterinary anthrax vaccine) and diagnostics.[69] Biokombinat currently employs 150 personnel.
- Institute of Plant Physiology, Genetics and Bioengineering (IPPGB): The IPPGB, located in Almaty, was created in 1994 on the basis of the Institute of Botanic and the Central Botanic Garden of the Academy of Sciences. It focuses on the development of genetically modified plants (rare and economically important plants), the development of biological compounds like bio-pesticides, and plant growth and resistance regulators. The IPPGB has an applied research base of 50 hectares of land.

Because of numerous changes that have taken place since 1993, today's NCB is a totally different entity from its Soviet ancestor, the Progress Scientific and Production Association. Their only common elements are the SNOPB, renamed Biomedpreparat in 1993, and what remains of Plant Progress, i.e., the equipment and personnel transferred to today's NCB member organizations located in Stepnogorsk. It is on these common elements that our study will concentrate: the NCB management entity, Biomedpreparat, the IPB (Aspect-pharm included), and the Environmental Monitoring Laboratory, all located in Stepnogorsk.

D. A New Partnership: U.S. Government Engagement

Soon after the creation of the NCB, the U.S. government provided support to the Kazakh government for converting former Soviet BW facilities located on Kazakh territory. Unfortunately, the early attempts at conversion in Stepnogorsk were unsuccessful for reasons that encompassed technical, political, social, and economic factors. From this initial failure, the belief that conversion was not possible at Stepnogorsk shifted U.S. assistance from conversion to dismantlement activities. But, the question remains as to whether conversion could still occur at Stepnogorsk. It is important to analyze both the conversion and dismantlement activities at Stepnogorsk

[68] The institute produces 18 animal vaccines and 38 diagnostics. Brochure provided by S.M. Mammadeliev, director of SRAI, "National Biotechnology Center of the Republic of Kazakhstan. Scientific Research Agricultural Institute."

[69] Brochure, "National Centre on Biotechnology, Republic of Kazakhstan," (Stepnogorsk: Ministry of Energy, Industry, and Trade, 2000).

to understand the role and effectiveness of U.S. assistance and what this has to say about whether future conversion efforts are still possible.

1. Breaking Ground: U.S. and Kazakh Agreements

Early on, U.S. government support of defense conversion in Kazakhstan (and the broader role of U.S. government assistance) was used as both a "carrot" and reward for Kazakh cooperation in the renouncement of its nuclear weapons and ratification of the START I treaty. In addition, then-Secretary of Defense William Perry was a strong supporter of the idea that nonproliferation involved addressing the economic stability of former weapons facilities and their scientists. Conversion activities within Kazakhstan began under a 1994 U.S.-Kazakh bilateral agreement, known as the Defense Conversion Implementing Agreement. This agreement established the Joint Committee for Defense Conversion, which included both Kazakh and U.S. representatives.

The Joint Committee for Defense Conversion was tasked with designating a list of eight Kazakh defense enterprises that would be eligible to receive funds from the U.S. government for conversion (see Table 1), and with coordinating all Kazakh international conversion programs. The principal objective of this program was to link U.S. private businesses and Kazakh defense enterprises in conversion programs that would be partly financed by the U.S. government and U.S private partners. In this first set of conversion programs, $14.7 million in U.S. government funding was allocated to finance joint projects between U.S. and Kazakh enterprises. An additional $21.2 million was to be invested by participating U.S. private enterprises, bringing the total investment to $35.9 million.[70] Facilities formerly engaged in work involving weapons of mass destruction received priority. Four key facilities, known as the "Fast Four," were ultimately selected for conversion funding; the National Center for Biotechnology (NCB) was one of these enterprises.[71] The NCB conversion project would be conducted at Biomedpreparat. Eleven other

[70] Newly Independent States Nonproliferation Database, Center for Nonproliferation Studies, Monterey Institute of International Studies.

[71] At this time, the U.S. government knew about the Stepnogorsk facility from its debriefing sessions with defector Ken Alibek. When the Kazakh government submitted Stepnogorsk on its initial list of prospective conversion projects, the U.S. government jumped at the chance to engage this facility. U.S. government official, interview by authors, Washington, DC, 20 August 2001. The other three "Fast Four" projects involved: (1) Gidromash (missile and aircraft systems production facility); (2) the National Nuclear Center (basic research and testing of nuclear weapons); and (3) Kazinformtelecom (maintains Saryshagan missile test range, telecommunications). Although this

Kazakh enterprises were also selected to participate in the second stage of this conversion program.[72] The conversion program would be funded under the U.S. Department of Defense's Cooperative Threat Reduction (CTR) Program.[73]

2. The Allen & Associates Project

In March 1995, a $2.7 million contract was awarded to the Biomedpreparat facility for a defense conversion project designed to manufacture and distribute vitamins, pharmaceuticals, antibiotics, and pharmaceutical supplies.[74] Subsequently, the firm Allen & Associates International (AAI) was selected as the defense conversion partner for Biomedpreparat through a U.S. government contract bid.[75] For its part, AAI was to provide an additional $3.1 million in a cost sharing agreement for the joint venture, which was to be called "Kamed Resources."

A few months after AAI was awarded the contract, AAI representatives visited the facility and determined that most of the Biomedpreparat buildings and other infrastructures were not suitable for pharmaceutical production. Kazakh officials were interested in using the production and research buildings, as well as the bunkers for the joint venture.[76] AAI, however, was con-

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particular U.S. program focused on Kazakhstan, defense conversion projects were initiated in each of the nuclear successor states. See U.S. General Accounting Office, *Cooperative Threat Reduction: Status of Defense Conversion Efforts in the Former Soviet Union*, GAO/NSIAD-97-101 (Washington: U.S. Government Printing Office, April 1997), p. 22; and Office of the Coordinator of U.S. Assistance to the NIS, *U.S. Government Assistance to and Cooperative Activities with the New Independent States of the Former Soviet Union, FY 1998 Annual Report* (Washington, DC: Office of the Coordinator of U.S. Assistance to the NIS, January 1999), p. 154.

[72] "Soedinenie Shtati poderzhivaiut konversiu v Kazakhstane" (The U.S. supports conversion in Kazakhstan), *Kazakhskaia Pravda*, 13 July 1994.

[73] In 1991, U.S. Congress passed the Soviet Nuclear Threat Reduction Act, more commonly known as the Nunn-Lugar Cooperative Threat Reduction (CTR) Program. This program provided the Department of Defense with the authority to fund assistance to eligible states in the Former Soviet Union to dismantle and destroy weapons of mass destruction, to strengthen the security of nuclear weapons and fissile materials, to prevent proliferation, and to help demilitarize the industrial and scientific infrastructure involving former weapons facilities in the NIS. See http://www.dtra.mil/ctr/ctr_index.html.

[74] U.S. General Accounting Office, *Cooperative Threat Reduction*, p. 22.

[75] Dimitar Antonov, AAI, interview by authors, Washington, DC, 27 August 2001.

[76] Apparently, building 211 was never considered for the conversion venture, since Kazakh officials had already envisioned using this facility for their own commercial production of nutrient media. The project, however, was never implemented. Dimitar Antonov, interview by authors, Washington, DC, 27 August 2001.

Table 1: Kazakh Enterprises Selected for Defense Conversion*

Enterprises participating in the international conversion program: Stage 1	Enterprises selected for the international conversion program: Stage 2
- National Center of Biotechnology, Biomedpreparat (Stepnogorsk) - Kazinformtelekom (Almaty)/ National Center for radio electronics and communications (Druzhnyi) - National Nuclear Center (Kurchatov city) - Kaskor (Aktau) - Heavy Machine Building Plant (Petropavlovsk) - Machine Building Plant (Almaty) - Guidromash (Almaty) - Zenit (Uralsk)	- Ziksto (Petropavlovsk) - Zavod Ispytatelnykh mekhanizmov (Petropavlovsk) - Kirov plant (Petropavlovsk) - Tynye (Kokshetau) - Omega (Uralsk) - Metallist (Uralsk) - Keramika (Ust-Kamenogorsk) - Kazakkumulator (Taldykorgan) - Etalon (Almaty) - Non-organic products plant (Serebriansk) - Nauka-Vostok (Kokshetau)

* U.S. General Accounting Office, *Cooperative Threat Reduction: Status of Defense Conversion Efforts in the Former Soviet Union*, GAO/NSIAD-97-101 (Washington, DC: U.S. Government Printing Office, April 1997): 22; and Office of the Coordinator of U.S. Assistance to the NIS, *U.S. Government Assistance to and Cooperative Activities with the New Independent States of the Former Soviet Union, FY 1998 Annual Report* (Washington, DC: Office of the Coordinator of U.S. Assistance to the NIS, January 1999), 154.;"Soedynyonye Shtaty poderjyvayut konversiu v Kazakhstane" (The U.S. supports conversion in Kazakhstan), *Kazakhskaya Pravda,* 13 July 1994.

cerned about the possibility of BW contamination within these buildings. Ultimately both sides agreed on Biomedpreparat's infirmary as the site for the joint venture since it was the one building that had never been associated with BW activities. The infirmary, however, was not without its problems. Due to recent flooding, the basement of the building was submerged in water. Because of this, the building required significant renovations to prepare it for commercial activities. Furthermore, the renovations and implementation of the project were delayed by interruptions in power and water supplies because Biomedpreparat could not regularly pay its utility bills.

In May 1996, AAI brought in ICN Pharmaceuticals, Inc. to provide additional expertise in execution of the conversion project.[77] In particular, ICN was to prepare a full technical design

[77] ICN had already been working with its Belgrade-based subsidiary, Galenika, to import and register a variety of pharmaceutical drugs and products in Kazakhstan. Dimitar Antonov, interview by authors, Washington, DC, 27 August 2001; ICN Pharmaceuticals, Inc. News Release, "ICN Pharmaceuticals and Allen & Associates To Convert Former Soviet Scientific Production Complex Into Drug-Manufacturing Facility,"14 May 1996, at http://www.icnpharm.com/.

for the conversion scheme in the infirmary. At a later time, ICN would also provide training in pharmaceutical methods and standards to Biomedpreparat employees, as well as import pharmaceutical products for packaging. Given the inherent difficulty in renovating the infirmary to meet international pharmaceutical production standards, AAI and ICN decided that there would be no on-site pharmaceutical production. Instead, the focus was on importing and packaging different types of pharmaceutical products, starting first with vitamins and then moving to analgesics. Only pills and powdered products were planned since these were much easier and less expensive to handle than liquid preparations. Once this plan was outlined, AAI shipped one million dollars worth of pharmaceutical manufacturing equipment, such as pill presses and packaging lines, to Stepnogorsk. Disagreements between AAI and Biomedpreparat, however, caused additional delays in project implementation.

Owing to mounting technical and financial problems (further described below, section E), AAI had difficulty meeting the deadlines set by the U.S. government. Because of this, AAI put in requests for contract amendments to the Department of Defense to compensate for these logistical problems and delays. However, these requests came too late. By spring 1997 the U.S. government decided to terminate the contract between AAI and Biomedpreparat. AAI quickly filed a lawsuit for breach of contract, and the U.S. government eventually settled out of court with Allen & Associates for $2.1 million.[78]

3. From Conversion to Dismantlement: The Dismantlement Process

Back in the United States, by the time the fiscal year (FY) 1996 budget appropriations were debated, the Republican stronghold in both the House and Senate opposed future CTR program support for defense conversion.[79] The House Armed Services Committee (HASC) added legislative restrictions to eliminate funding authority for defense conversion. Within this context, when the House authorization bill moved from the HASC to the House floor, an amendment was added to suspend all CTR funding for Russia until the U.S. president certified that Russia was in

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[78] Michael Dobbs, "Soviet-Era Work On Bioweapons Still Worrisome," *Washington Post*, 12 September 2000, p. A1.

[79] Richard Combs, "U.S. Domestic Politics and the Nunn-Lugar Program," in *Dismantling the Cold War: U.S. and NIS Perspectives on the Nunn-Lugar Cooperative Threat Reduction Program*, ed. John M. Shields and William C. Potter (Cambridge: MIT Press, 1997), pp. 42-60.

compliance with its obligations under the Biological and Toxin Weapons Convention. This further complicated continued support for funding of defense conversion projects—especially projects at former BW facilities. Eventually, these HASC restrictions were endorsed by the Senate Armed Services Committee. In FY 1996, Congress chose to stop funding the Defense Enterprise Fund (DEF), which underwrote U.S.-NIS defense conversion projects. To date, no new Congressional funding for Department of Defense CTR programs can be used to directly support defense conversion in Russia or the NIS.[80]

This Congressional shift also contributed to the final decision by the U.S. government to terminate the ill-fated conversion project at Biomedpreparat. In 1996, with the AAI project in shambles, attention turned to the subject of dismantlement of the facility. At the time the Kazakh government supported dismantlement for two main reasons: threat reduction and commitment to international norms. The Stepnogorsk facility was designed to produce and load large-scale quantities of biological weapons during a wartime mobilization period. Therefore, the continued existence of such a facility was a real security and proliferation threat. President Nazerbaev recognized these threats and said that upon learning of Stepnogorsk, his first desire was, "to rid ourselves of that [facility], and more importantly to rid ourselves of the consequences."[81] In addition, Kazakhstan desired to be a member in good standing of the international community. The construction of the Stepnogorsk facility started in 1982, seven years after the USSR had ratified the BTWC and it had entered into force. This was a clear violation of an international arms control agreement. The new Kazakh government did not want to start off its international standing by continuing to maintain an illegal facility.[82] For these reasons, the United States and Kazakhstan chose to pursue dismantlement at Stepnogorsk.[83]

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[80] However, prior year CTR funding (pre FY 1996) that remains unspent can be used or reallocated to support conversion activities. In addition, non-governmental and international assistance can be used to support current conversion projects.

[81] Dana Lewis, "Interview with President Nazarbayev," http://www.msnbc.com/news/406276.asp, accessed January 2002.

[82] At the time, however, Kazakhstan was not a State Party to the BTWC. Therefore, technically speaking, Kazakhstan was not bound by the treaty. To date, Kazakhstan has not signed and ratified the treaty.

[83] As a caveat, former Soviet bioweaponeer Ken Alibek states that in June of 1992, the newly formed Kazakh Ministry of Defense was interested in recruiting him to manage a new Kazakh BW directorate, as outlined in a draft agreement between the Biopreparat agency (Russia) and the Kazakh Ministry of Defense. Alibek states that the chief of the defense section in the Kazakh president's administration was involved in these recruitment efforts. Alibek

The first U.S. government visit to Stepnogorsk occurred in 1995, a few months after the award for a conversion project with AAI.[84] Although the U.S. delegation had received Kazakh government approval for the visit, this did not ensure open arms in Stepnogorsk. Dr. Lepyoshkin sent his representative to tell the delegation that they were not welcome either in the town or the facility. Tense discussions ensued, with U.S. government officials pressing for approval to visit the site. Eventually, Lepyoshkin granted the team access to the town, but refused to allow them access to the weapons facility, arguing that he had not received an official statement from the Kazakh government to allow U. S. government representatives access to the site. Finally, U.S. officials obtained a letter from the American embassy stating that they had Kazakh approval to go on-site, and Leypyoshkin relented.

During the tour of the facility Lepyoshkin gave the delegation full access to the buildings and rooms formerly used for weapons purposes. Yet he refused to tell the U.S. team what work was done within these rooms or what the equipment was used for in the past. Lepyoshkin maintained that the equipment was used for vaccine production. Although the atmosphere was initially tense, this dissipated as the site visit progressed. In fact, at the end of the visit, Lepyoshkin ended up accompanying the U.S. delegation on their visit to former BW proving grounds at Vozrozhdeniye Island. In spite of the initial hostile atmosphere, subsequent U.S. government discussions and interactions with Lepyoshkin were more constructive.

After this visit, the Department of Defense realized that Stepnogorsk could be a showcase project of U.S. government BW nonproliferation assistance. Since Lepyoshkin exhibited more openness and a spirit of cooperation as the visit progressed, the Department of Defense felt that a constructive working relationship could be arranged. From this, Assistant Secretary of Defense Ashton Carter and Ambassador William Courtney formulated the proposal to start a major U.S.

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feels, however, that this desire to retain BW by the new government was not made after a careful military or political assessment. Alibek speculates that the government's early interest in BW was possibly due to two reasons: (1) the initial desire to retain some capability or infrastructure related to weapons of mass destruction since they had already renounced their nuclear weapons, or (2) to keep the Biomedpreparat facility intact for leveraging purposes related to future U.S. negotiations for additional nonproliferation assistance. Alibek states that he does not believe that President Nazerbaev wanted to stay engaged in the BW business. Alibek and Handelman, *Biohazard*, pp. 247-50; Ken Alibek, interview by authors, Manassas, Virginia, 22 August 2001.

[84] U.S. government official, interview by authors, Washington, DC, 22 January 2001. For an additional description of this visit, see Judith Miller, Stephen Engelberg, and William Broad, *Germs: Biological Weapons and America's Secret War* (New York: Simon & Schuster, 2001), pp. 165-82.

government effort at Biomedpreparat called, "The Stepnogorsk Initiative." Separate from the AAI project, this initiative was envisioned to involve assistance for dismantlement of the facility and redirection of its bioweapons scientists. Within the U.S. government, an interagency Stepnogorsk Initiative working group was formed, with oversight by the Office of the Coordinator of U.S. Assistance to the NIS, to manage these efforts and develop new peaceful scientific activities for the facility and personnel. The initial proposal for dismantlement was aimed at only eliminating certain biocontainment (i.e., ventilation, filtration) equipment and not the large-scale (20,000 liter) fermentors.[85] This is because Biomedpreparat officials still hoped to use the fermentors for commercial production of pharmaceuticals (even though they had yet to identify a viable product or customer).[86]

In June 1996, the Kazakh government signed an amendment to the existing CTR agreement to include dismantlement of the Biomedpreparat facility. One month later, a U.S. interagency team visited Stepnogorsk for a technical evaluation of requirements for demilitarization and discussion of redirection possibilities. A tour of the facility revealed that there was no evidence of existing BW activity, with the appearance that several of the buildings had gone unheated for several years. Also, there were visible signs of attempts at conversion, such as the presence of syringe packing lines. Under consideration for dismantlement were the buildings that had the capability to produce, process, handle, and store BW materials. Ten buildings were identified as central to the production of biological weapons and therefore subject to dismantlement:[87]

- Building 221 was used for the production and fermentation of large quantities of microorganisms. The large building (150 meters long; 32 meters high; 24 meters wide) consisted of eight stories, two of which were underground (7 yards below the surface). This building was equipped with bio-safety equipment (i.e., ventilation system, submarine doors), autoclaves which sterilized all contaminated material coming from the hot zone, 20 fermentors with a 1,000 liters capacity, 10 fermentors with a 20,000 liters capacity (each of which was four stories high), as well as a genetics laboratory.

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[85] Aerosol test chambers (in building 600) and product filling lines (in buildings 241-243) had already been removed in the early 1990s by the Russian government. Brian Hayes, presentation, "Protection of Biological Weapons Proliferation through Cooperative Threat Reduction Programs," at conference on "Former Biological Weapons Facilities: Dismantlement and Prospects for Conversion," Stepnogorsk, Kazakhstan, 24 July 2000; Ken Alibek, interview by authors, Manassas, VA, 22 August 2001.

[86] U.S. government official, telephone interview by Kathleen M. Vogel, 29 May 2001.

[87] For a more detailed description of the activities held in each building, see Bozheyeva et al., *Former Soviet Biological Weapons Facilities in Kazakhstan*.

- Building 211 was used to produce liquid nutrient media. Building 211 was linked to Building 221 by a system of pipes transporting the media used for the culture of micro-organisms that took place in building 221.
- Building 231 was specifically designed for drying and milling of anthrax bacteria. However, the building was never used for weapons activities.[88]
- Building 600 was the R&D facility. It housed a unique testing system, a 300-m^3 explosive aerosol test chamber, composed of a round cement platform and a dome overhead. Experimental animals were placed on the platform, the dome lowered, and extremely dangerous bacterial and viral agents were liberated into the chamber. Subsequently, a robust ventilation system sterilized the room before scientists were allowed to come in and work with the infected animals.
- Buildings 241 to 244 consisted of bunkers. Inside these bunkers, BW technicians filled munitions and storage containers with biological agents.
- Buildings 251 and 252 were bunkers that were used to perform the final assembly and storage of weapons. The bunkers had two-meter concrete walls and thick metal doors.

In September 1996, a proposal was developed for the initial contract that described the technical requirements for demilitarization of these facilities. By October 1996, a joint U.S.-Kazakhstan committee had reviewed and approved the proposed demilitarization project that would involve two phases. Phase I would consist of pre-dismantlement activities involving: (1) sampling/analysis, (2) inventory, (3) construction of a safety-monitoring laboratory, and (4) development of a detailed dismantlement plan.[89] Phase II would consist of the actual dismantlement work. In December 1996, the Department of Defense signed a $1.85 million contract with Biomedpreparat for Phase I.[90]

a. Phase I: A Promising Start [91]

Under Phase I, U.S. and Biomedpreparat workers conducted an inventory of all BW-relevant equipment/systems. This resulted in a detailed dismantlement plan and protocol for each

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[88] In fact, the building was virtually collapsing during the 1995 Department of Defense evaluation. U.S. government official, interview by authors, May 2001.

[89] U.S. Department of Defense presentation, "Demilitarization of the Biomedpreparat Facility at Stepnogorsk," NAS Committee Meeting, 6 February 1997.

[90] Ibid.

[91] This section is mainly based on Brian Hayes' presentation at the Stepnogorsk conference July 2000, supplemented by further discussions between the authors and a U.S. government official.

Overview of the SNOPB complex. The photo was taken in the spring of 2000 from Building 221. On the left are the mounds where the 240 series bunkers were located. Behind the bunkers are Buildings 600 and 231.

building floor covering such issues as worker safety, manpower, schedules, and costs. In addition, a series of sampling and biochemical analyses were made to determine the potential hazards of contamination and the necessary biosafety protection for the dismantlement work.[92] To support the analysis, it was determined that a local monitoring laboratory was needed. With additional U.S. government assistance, the Environmental Monitoring Laboratory was established in March 1998 with a total set-up cost of approximately $1.2 million (separate from CTR funding for Phase I and Phase II activities).

The Monitoring Laboratory was supplied with new equipment such as gas chromatographs (equipped with electron capture and flame induction detectors), a UV spectrophotometer, capillary electrophoresis, microscopes, and an automated workstation for immunoenzyme analysis (ELISA). The laboratory would analyze soil, water, and waste samples to determine the presence of metals, organo-chlorine, organo-nitrogen, organo-phosphate, pesticides, microbiological organisms, and industrial organic compounds.[93] Throughout the course of the dismantlement, 15,000 samples were analyzed at the Laboratory, with another 3,000 samples analyzed in the United States.[94] Although this laboratory was established specifically for dismantlement activities, the U.S. Department of Defense agreed that the laboratory equipment could remain after dismantlement to be utilized according to Kazakh interests. Therefore in 1999, the laboratory was designed as a National Monitoring Laboratory by the government of Kazakhstan. In addition to analyzing samples from the dismantlement work, the laboratory is equipped to conduct a variety of other biochemical, biophysical, microbiological, and environmental tests.

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[92] Under the sampling procedures, integrity and chain-of-command protocols were developed. Triplicate samples were obtained which were retained for the U.S., Kazakhstan, and an archived (on-site) sample at the Scientific Research Agricultural Institute in Otar; analyses of the samples were conducted by both U.S. and Kazakh scientists. During the early 1990s the Soviet government had employed a rigorous two-year decontamination campaign at the facility to hide prior offensive work at the facility. However, in order to determine any residual contamination, extensive sampling by U.S. and Kazakh scientists was conducted at each building slated for dismantlement. Throughout the dismantlement work, additional samples were taken for analysis to ensure no residual contamination. Although all samples returned with a negative result, in some areas some decontamination was used as a precautionary measure. For example, the fermentors and pipelines that previously contained active biological agents were subject to decontamination involving a specialized mixture of bleach and peroxide. U.S. government official, interview by authors, June 2001.

[93] Information gathered from a visit of the Stepnogorsk facility in April 2000 with Department of Defense officials.

[94] U.S. Assistance to the NIS, 1998 report, p. 155; U.S. government official, interview by authors, Springfield, VA, 1 November 2001.

b. Phase II: Progress and Problems

Phase I was completed in May 1998 and a follow-on contract for Phase II was awarded to Biomedpreparat in September 1998. Phase II involved actual dismantlement of the production infrastructure (including breathable air-system, submarine doors, butterfly valves, air filtration system, and certain non-load bearing walls in containment areas), namely in buildings 221, 231, and 600.[95] Plans were developed and the actual dismantlement work started in January 1999. U.S. Department of Defense officials consider Phase II work a great success. The dismantling team, however, encountered a number of engineering and logistical problems that they had to overcome during project execution.

For example, in building 231, dismantling the large drying machines proved challenging; one dryer weighed over 200 tons. Since this equipment had to be removed from the building, Biomedpreparat needed to acquire specialized lifting devices and cranes. Perhaps more significant, portions of the dismantlement work were carried out during the winter months where the temperature frequently dropped to -30/C. The buildings had been without electricity, heating, and water for five years and many pieces of equipment used for the dismantlement would freeze at -20/C. Electrical shortages, freezing of disinfectants, and poor ventilation conditions were also problematic during the winter months.[96] For example, the power station that provided the facility with electricity was only intermittently in service. Appropriate physical protection of workers was also a major issue. Special equipment and clothing that could simultaneously protect workers from hazardous materials and keep them warm were needed. Since the facility was located

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[95] The original U.S. plans consisted of dismantling only the equipment that was unique to the pathogenic microorganisms (e.g., special bio-containment systems, air handling and waste treatment systems that allowed the building to maintain negative pressure and protect the environment). The buildings, as well as the large-scale fermentors, were to be preserved and if possible converted to peaceful purposes. In 1998, a team of U.S. technical experts evaluated the facility for additional prospects of conversion. These experts determined that the cost of upkeep and maintenance to run the large fermentors for commercial pharmaceutical/vaccine production would be prohibitive. In subsequent discussions with these experts, Lepyoshkin conceded the futility of using these fermentors for commercial production and recognized the economic gain from their dismantlement (via a CTR contract). As a result, Lepyoshkin agreed to include the fermentors in the dismantlement contract. U.S. government official, telephone interview with Kathleen M. Vogel, 29 May 2001.

[96] Work had to stop and employees leave the building every 40 minutes in order to ventilate the working area. Yuri Rufov, presentation at Center for Nonproliferation Studies, Monterey Institute of International Studies, Monterey, CA, 13 December 1999. Decontamination efforts at Ft. Detrick in 1972-1973 were also delayed due to difficulties in maintaining the required temperature conditions for the decontamination process during the winter months. U.S. Department of Health, Education, and Welfare, Public Health Service, NIH, DHEW Publication No. 74-555, July 1973.

outside of the Stepnogorsk city limits, worker transport to and from the dismantlement area was another problem, especially in winter with snow and poor road conditions.

Because of these issues, certain measures were taken in order to facilitate execution of the project. A service area (showers, medical point, resting/lunch room, locker room), as well as a bacteriological laboratory for rapid diagnostics, was created in building 261, which was considered the cleanest of all the buildings. A diesel power source with a capacity of 15 kW was installed in building 261. In order to allow a sufficient energy supply for the other buildings being dismantled, another diesel power station with a capacity of 100 kW was also purchased. Before the energy supply and portable space heaters were added to the buildings, the workers used to warm themselves in a rented bus during the cold winter months. Water was transported to the site by truck and heated using the diesel power station installed in building 261.

In spite of all of these hardships, Phase II stayed essentially on track. After the completion of work in Building 221, the dismantling team tackled building 600, which was completed in November 1999. That winter, dismantlement work was conducted in the 240 and 250 series of bunkers, along with building 221. The total costs for Phase I and Phase II dismantlement work is summarized in Table 2.

In total, 120 people were involved in the dismantlement project, of which 40 percent were laborers and approximately 60 percent administrative support personnel. Laborers received approximately US$180 per month (a good salary for the region), with benefits of specialized medical care and food supplements.[97] Once Phase II was completed in September 2000, all BW equipment and infrastructure had been destroyed; there were no remaining proliferation or offensive threats from the infrastructure or materials from the facility.[98] The work was completed with no major injuries to the Kazakh work force and done in a safe and ecologically sound manner.

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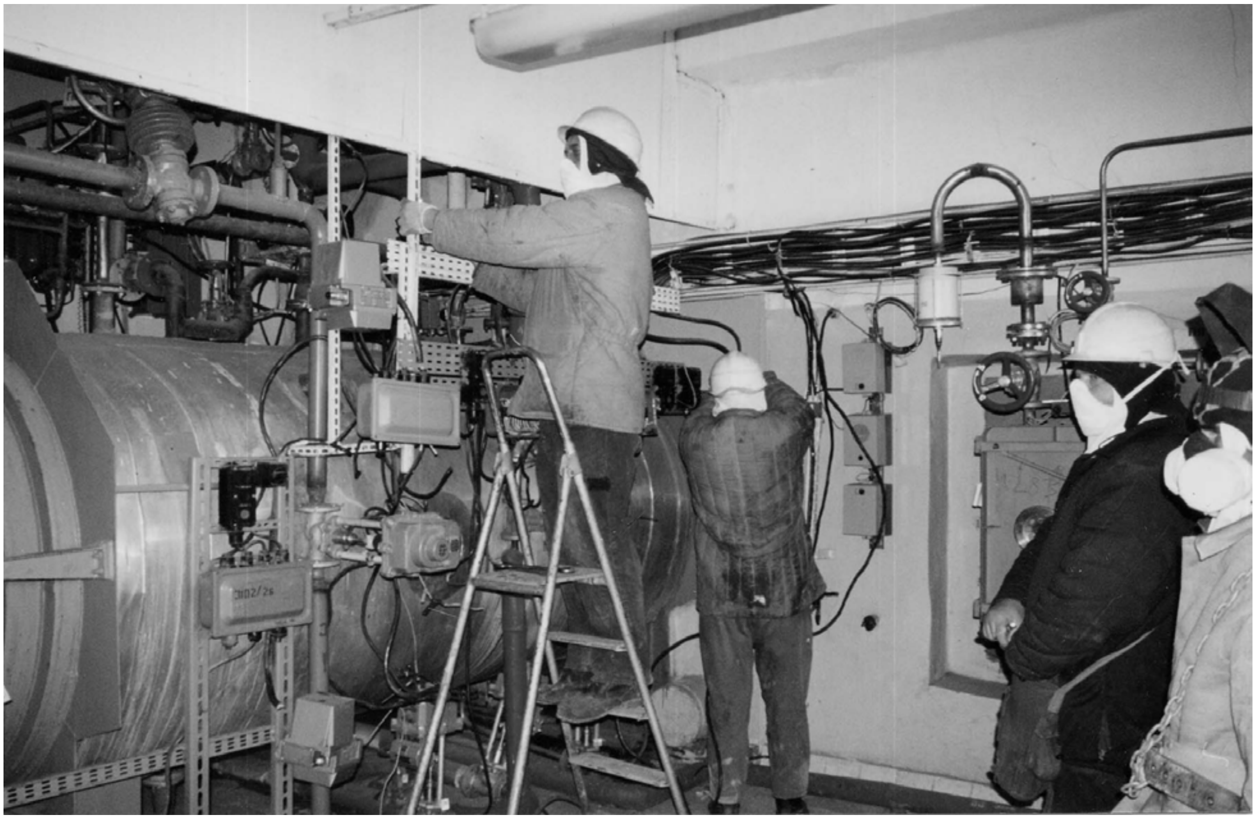
[97] Yuri Rufov, "Review Report About Processing Works on DSWA-DTRA Contracts for Destroying of Biological Equipment Infrastructure at JSC Biomedpreparat," presentation at conference on "Former Biological Weapon Facilities: Dismantlement and Prospects for Conversion," Stepnogorsk, Kazakhstan, 24 July 2000. These laborers frequently earned more money than senior bioweaponeers, since the dismantlement activities were conducted in a hazardous work environment.

[98] However, former weapons personnel still remain in Stepnogorsk and pose a brain drain proliferation threat.



Former SNOPB employees dismantling a large autoclave in Building 221 with assistance provided by the U.S. Cooperative Threat Reduction Program.

c. Phases III & IV: An Uncertain Future

Under the original terms of the contract, once Phase II was completed, CTR assistance for dismantlement at Biomedpreparat would end. During a May 2000 visit by Ambassador Richard Jones to Stepnogorsk, Biomedpreparat officials told him that although proliferation-sensitive equipment would soon be destroyed, there would remain residual contamination within the buildings, posing serious environmental and public health hazards. Biomedpreparat officials proposed that elimination of these hazards could be achieved only by complete demolition and decontamination of the buildings. Biomedpreparat officials said they would be glad to continue cooperation with the U.S. via a new 5-year, $11 million contract to support these additional dismantlement activities.

The issue of contamination came as a surprise to U.S. government officials. From the outset and throughout the course of the contract, multiple samples had been taken from all parts of the buildings undergoing dismantlement. On record, there was no documentation of any

Table 2: Dismantlement Costs at Biomedpreparat for Phase I and II

Task	Cost (in U.S. dollars)
Labor (salary, supplemental pay, medical benefits, vacation)	$344,000
Equipment, tools, design documents	$343,000
Transportation and equipment rentals	$25,000
Power supplies (diesel generators, space heaters)	$15,000
Overhead (sanitary and hygienic oversight, water/sewage)	$41,000
Labor safety (protective suits and gear)	$29,600
Medical equipment and devices	$52,000
Daily special diet for workers	$7,000
Transportation of employees to and from site	$55,000
Social Security payments	$184,000
Biomonitoring	$55,000
Legal and accounting	$10,000
Management and administrative costs	$221,000
Total	$1,381,600

T. Lychkovska, "Planning and financing works for destruction of biological equipment infrastructure at JSC Biomedpreparat," presentation at conference on Former Biological Weapon Facilities: Dismantlement and Prospects for Conversion, Stepnogorsk, Kazakhstan, 24 July 2000.

contamination found either by Kazakh or U.S. scientists. The original CTR contract even stipulated that any samples found with contamination should be retained and logged. Throughout the course of the dismantlement no mention had been made of any suspect samples. Towards the end of the Phase II contract, however, Biomedpreparat officials charged that new samples (taken independently by Kazakh scientists) did show residual contamination. When asked to produce these samples for U.S. analysis, Biomedpreparat officials stated that they had not kept the samples. Debates continued back and forth regarding the legitimacy of the contamination claims.

In spite of suspicions about the truth of the alleged contamination, CTR officials did see merit in the idea of additional dismantlement activities to ensure no possibility of residual contamination or future reversion of the facility to offensive use. Therefore, CTR officials agreed to support an additional Phase III and Phase IV of the dismantlement. Phase III would consist of removing all supporting infrastructure not part of the BW production process, such as electrical power and plumbing from building 600, and preparing the building for elimination; demolition was to be conducted under the Phase IV contract.[99] Although the original $11 million proposal by the Kazakhs was not acceptable, CTR officials did explore more reasonable cost considerations for these final two phases. Through a series of negotiations between CTR officials and Capitol Hill, Congress authorized Phase III and IV with a total funding of $5.0 million (using a reallocation of unspent FY 1998 funds) in the spring of 2000.

Before the end of Phase II, Phase III was initiated in September 2000 to keep the Biomedpreparat workforce employed and prevent a loss of momentum in future dismantlement activities. Phase III was completed in December 2000 at a cost of $300,000. During this period, Phase IV contract negotiations were being hammered out with Biomedpreparat officials to finalize complete elimination of all three main production facilities (buildings 600, 221, 231). Negotiations for this final portion of the project, however, proved to be the most frustrating and contentious of all.

Prior to Phase IV negotiations, the DOD contracted with two expert engineering firms in the area of infrastructure elimination. These firms provided a cost estimate of $1.8 million for U.S. companies to handle all of the elimination (using local equipment and U.S. workers). Based on these discussions and cost estimates, the U.S. projected costs for Phase IV dismantlement were internally set at $3.0 million; funding would not be denoted in Kazakh Tenge (see Table 3). In contrast to using U.S. engineering firms, this contract would be awarded directly to Biomedpreparat and use local labor and resources. The elimination was determined to take 15 months, which included no work during the harsh winter months.

Initial Phase IV contract negotiations took place during July 2000. At the outset, the Biomedpreparat team (led by Yuri Rufov, president of Biomedpreparat) submitted a new cost and scheduling estimate for the dismantlement: $12.9 million over a 5-year period. U.S. officials balked at this proposal and countered with a much lower initial offer of $2.3 million. The U.S. and Biomedpreparat officials continued to haggle over the cost estimates, with Stepnogorsk personnel alleging additional contamination problems in the buildings. In the second round of talks, Biomedpreparat officials proposed a $6 million figure. The U.S. countered with an offer of $3.0 million that would include funds to cover additional sampling tests and equipment for the Mon-

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[99] Note that the unique aerosol testing system that was formerly in this building was destroyed in 1991 by decision of the Soviet government. This destruction occurred four years before the first American team came to Stepnogorsk.

itoring Lab. This was not deemed acceptable by Biomedpreparat. The negotiation intensified as the two sides failed to come to an agreement. Biomedpreparat officials, due to their poor economic situation, were determined to secure a substantial long-term contract for the demolition to provide some measure of job security for their workers.

Table 3: Estimated Plan for Phase IV Destruction

Task	Cost
Development of Management Action Plan	$50,000
Development of Safety/Waste Disposal Plan	$50,000
Personnel Training	$50,000
Development of Sampling and Monitoring Plan	$50,000
Development of Destruction Plan (starting with Building 600, then 231, 221)	$50,000
Destruction of Building 600: Removal of equipment, ball and crane operation, clean-up	$700,000
Destruction of Building 231: Removal of equipment, ball and crane operation, clean-up	$1,000,000
Destruction of Building 221: Removal of equipment, ball and crane operation, clean-up	$1,000,000
Completion of Destruction Report	$50,000

Source: U.S. government official, personal communication to authors, 29 May 2001.

At the time of this negotiation, an international conference was being held in Stepnogorsk on the subject of the BW nonproliferation and biotechnological development in Kazakhstan.[100] To the surprise of the U.S. officials and other foreign participants, the conference turned into a forum for complaints concerning U.S. assistance. Several of the Biomedpreparat officials and other NIS participants openly criticized shortcomings in CTR assistance. One scientist complained, “The Americans just want to destroy, they don’t want to create anything.”[101] This attitude did not do much to soften the U.S. negotiating position on dismantlement. The U.S. remained adamant in its offer of $3.0 million, which it felt was generous and more than adequate to fulfill all aspects of Phase IV. This was not acceptable to Biomedpreparat officials, and so the U.S. team left Stepnogorsk in July 2000 with no contract agreement. Once back in the States and upon further consideration, U.S. officials agreed to raise the contract offer to $3.5 million to cover additional expenses for some decontamination activities. One week later, Biomedpreparat

[100] “Biotechnological Development in Kazakhstan: Nonproliferation, Conversion, and Investment,” Stepnogorsk, Kazakhstan, 24-26 July 2000. See http://cns.miis.edu/cns/projects/nisnp/research/bioweap/step.htm.

[101] Dobbs, “Soviet-Era Work on Bioweapons Still Worrisome,” p. A1.

officials came back with a counteroffer of $4.9 million (with no mention of the issue of contamination). With the lack of evidence for contamination, however, the U.S. government refused to accept the offer. Yet the communication lines remained open between Stepnogorsk and Washington.

In the meantime, some other administrative and organizational changes within the CTR program were implemented. In the summer of 2000, Bechtel Group, Inc. was awarded a contract to execute the Phase IV contract. Bechtel was chosen for this task in connection with the Department of Defense's "long-term strategic plan" regarding the entire BW proliferation prevention program under CTR. Bechtel was brought on to serve as the prime contractor and in-country support for all future BW dismantlement and nonproliferation projects in Russia and the NIS. However, in accordance with company policy at the time, Bechtel employees were not allowed to work in hazardous environments. Therefore, it was decided that Phase IV would be carried out via a sub-contract with Biomedpreparat workers. In spring 2001, however, Biomedpreparat had not yet agreed to the $3.5 million U.S. government proposal for Phase IV dismantlement. With these uncertainties, the United States informed the Kazakh Ministry of Energy, Industry and Trade of its intention to stop dismantlement work at Stepnogorsk if the issue of residual contamination could not be resolved. That summer, another round of negotiations between U.S. and Kazakh government officials led to an agreement to conduct a joint sampling exercise to settle once and for all the contamination issue.

To add to the tumultuous atmosphere, a May 2001 Kazakh government reorganization resulted in the removal of Dr. Gennady Lepyoshkin from his post as director of the NCB and Dr. Vladimir Bugreev as Director of the IPB; Dr. Alexander Kossinov, director of the Monitoring Laboratory, was demoted. The new director of the NCB, Dr. Sergazy Adikenov, does not seem to be interested in the Phase IV contract and appears to be more interested in moving existing equipment from the Monitoring Lab to his home city of Karaganda.[102] In October 2001, a U.S. government sampling mission of Building 221 found positive contamination of *Bacillus* bacteria within pipelines located on the 9.6-meter level. Preliminary tests only confirmed the presence of a gram-positive *Bacillus* bacteria; additional tests would need to be conducted to identify the

[102] Karaganda is Kazakhstan's second largest city, with an approximate population of 500,000. It is located 400 km southeast of Stepnogorsk.

exact species of *Bacillus*. Eventually, detailed analyses determined that the contaminant was *Bacillus thuringiensis* and not *Bacillus anthracis*.[103] Since these tests were taken, Biomed-preparat officials have determined that the spores are localized and have already undertaken decontamination measures. Given the scope of weapons activities in building 221, the finding of residual contamination is not completely surprising. However, U.S. officials find it disconcerting that they were not informed of this problem earlier. Apparently, Kazakh officials admitted that they had known of this contamination much earlier and failed to report it. Since then, U.S. officials have received certificates from the government of Kazakhstan ensuring that all remaining buildings slated for destruction have no evidence of residual contamination.

As of December 2002, U.S. and Kazakh officials are negotiating to iron out the final details of the building demolition.[104] Remaining issues concern whether implosion or a ball and crane operation will be selected as the method of building demolition. In order to prevent a loss of momentum while these issues are fully resolved, the Phase IV project will be handled in four separate contracts. Phase IVA, B, and C has already involved the removal of ancillary equipment and other preparatory work for demolition from buildings 221, 231, and 600. The Phase IVD contract, still to be finalized, will handle demolition of all three buildings. If negotiations for this last contract proceed smoothly, demolition of the buildings should be completed in a matter of months.[105]

Privately, some U.S. officials working on the dismantlement project believe that Phase IV of the contract is not necessary. These individuals feel that since all of the offensive BW equipment and infrastructure has been destroyed and the buildings are already suffering from decay, a revival of BW activities could not be conducted there without significant investment of money and time. These individuals believe that Phase IV of the contract should not have been pursued, and those monies should have been reallocated to other dismantlement projects in

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[103] *Bacillus thuringiensis* (BT) is a gram positive Bacillus in the same family as *Bacillus anthracis*. The BT bacteria produce a toxin that is not harmful to humans or animals, but is harmful to certain insects. The bacteria and its toxin are used worldwide against a variety of plant pests. The Progress Plant is known to have produced *B. thuringiensis* for commercial production. In addition, it is known that *B. thuringiensis* has been used to obscure the development of *B. anthracis* as a weapon. For example, Iraq used *B. thuringiensis* as a simulant for *B. anthracis* in its BW program.

[104] "Kazakhstan: U.S. Program to Destroy Bioweapons Plant Needs Compromise," *Novosti Nedeli*, 27 March 2002.

[105] U.S. government official, telephone interview by Kathleen M. Vogel, December 16, 2002.

Russia or other independent states. However, other U.S. government officials argue that demolition of the buildings will forever destroy any possible resurrection of a BW program and will be a symbolic end to the Stepnogorsk legacy. Furthermore, a Phase IV contract will provide for some employment and additional funding to employ Biomedpreparat weapons scientists. If the Phase IV contracts are agreed upon and work continues uninterrupted, complete building demolition should be completed by 2004.

d. Different Conceptions of U.S. Assistance

At the July 2000 conference in Stepnogorsk, "Biotechnological Development in Kazakhstan: Nonproliferation, Conversion, and Investment," presentations on the dismantlement of the Stepnogorsk facility revealed that the American and the Kazakh members of the audience hold different conceptions of U.S. assistance.[106] Although all the parties agreed on the need and the objectives of the dismantlement, they looked at the dismantlement process from different points of view. From the U.S. side, dismantlement mainly has a nonproliferation significance. Elimination of the specialized equipment and buildings not only removed the threat of a renewed BW production at Stepnogorsk, but also decreased the risk of proliferation of equipment and technologies.[107] In contrast, the view of the Kazakh participants was more complex. Although they did not question the nonproliferation objectives of the dismantlement, they clearly stated that the dismantlement was destroying a scientific and industrial wealth that was greatly needed in this period of economic transition. Note that these are not opposing points of view. Both sides recognize that the other party's view is well founded. Each side, however, stressed only one point of view depending on self-interest: security versus economy.

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[106] "Biotechnological Development in Kazakhstan: Nonproliferation, Conversion, and Investment." For another description of this conference see Roger Roffey and Kristina S. Westerdahl, *Conversion of Former Biological Weapons Facilities in Kazakhstan: A Visit to Stepnogorsk* (Umea: FOI, Swedish Defence Research Agency, May 2001).

[107] Early on, U.S. government officials recognized the importance of economic stability and viability of these former bioweapons institutes as a means to mitigate the threat of nonproliferation. Therefore, the Stepnogorsk Initiative was designed along with the dismantlement activities to assist in redirecting these bioweaponeers to peaceful purposes and improving opportunities for foreign investment. However, U.S. Nunn-Lugar assistance is first and foremost designed to address specific U.S. national security threats. NAS Committee Meeting, 6 February 1997; Anne Harrington, "Redirecting Biological Weapons Expertise: Realities and Opportunities in the Former Soviet Union," *CBW Conventions Bulletin*, no. 29 (September 1995): 2-5.

For some other Kazakh participants it was unclear why the destruction of the equipment and the buildings was preferred over their conversion to peaceful purposes, such as production of drugs or agricultural products. This point was clarified by Stepnogorsk representatives, who stated that the buildings and some of the remaining equipment could not have been used to produce products for the medical or agricultural sectors. As mentioned previously, teams of Western pharmaceutical experts had visited the Biomedpreparat buildings and determined that producing pharmaceuticals would be impossible due to poor building conditions and lack of Good Manufacturing Practices (see Appendix for further discussion). Overcoming these deficiencies would require large financial investments. In spite of this, some representatives of the facility seemed to regret the decision made by their government to destroy the facility and its equipment.

In addition, some Kazakh participants at the conference voiced their worries regarding U.S. motivations in supporting dismantlement at Stepnogorsk and future work in Russia. They found it suspicious that the U.S. did not destroy its former BW equipment and facilities, such as the aerosol test chamber at Fort Detrick.[108] Some claimed that the United States may be trying to eliminate potential competitors in order to remain the only world power capable of producing large quantities of biological weapons. This of course reveals the unawareness of some participants on the technical state of former offensive BW facilities in the United States.[109] President Nixon had indeed terminated the U.S. offensive BW program in 1969.[110] Dr. Lepyoshkin, who visited former U.S. BW facilities in 1997, confirmed this fact at the conference. Still, suspicions remain.

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[108] The "8 Ball" aerosol test chamber was a one-million liter sphere used to test weaponized agent. In 1977, the "8-Ball" was placed on the National Register of Historic Places by the U.S. Department of the Interior and remains intact at Fort Detrick.

[109] However, in 2001, press reports emerged that the U.S. Department of Defense and U.S. intelligence community had conducted questionable defensive activities. These activities have raised concerns across the international community as to whether they were permitted under the BTWC. Such activities do little to build trust within the former Soviet BW establishment. See Judith Miller, Stephen Engelberg, and William J. Broad, "U.S. Germ Warfare Research Pushes Treaty Limits: Pentagon Says Projects Are Defensive, and is Pressing Ahead," *New York Times*, 4 September 2001; Barbara H. Rosenberg and Milton Leitenberg, "Who's Afraid of a Germ Warfare Treaty," *Los Angeles Times*, 6 September 2001, p. 15.

[110] The former BW facility at Fort Detrick, Maryland was later converted and part of it was transformed into a museum. The production facilities at Fort Detrick and Pine Bluff, Arkansas have not been used since 1969, and are not in a state to be used.

The ambivalent feelings of some Stepnogorsk representatives regarding the dismantlement and destruction of the former facility and the suspicions regarding U.S. motivations were enhanced the second day of the July 2000 conference, when it became apparent that the initial Phase IV negotiations between U.S. government and Biomedpreparat officials had not gone smoothly.[111] However, it is worth noting that such an ambivalence was mostly due to the risk of losing an "economic wealth" (i.e., jobs, production facility) while no alternative solution was proposed.

E. Conversion Today

With Biomedpreparat dismantled and its main production buildings soon to be destroyed, one may ask whether it still makes sense to talk about conversion at Stepnogorsk. The failed conversion attempt of 1995-96 has nurtured the belief that conversion in Stepnogorsk is not possible. However, there are reasons to believe that this attempt at conversion should not serve as the basis for determining the feasibility of conversion in Stepnogorsk. As we will show below, the failure can be explained by the choice of a wrong approach and a wrong partner. The dismantlement and the destruction of buildings and equipment do not eliminate all prospects for conversion at Stepnogorsk, since only equipment and buildings central to BW production have been or will be destroyed. Dual-use equipment, and more important, personnel are still available for conversion. As a matter of fact, since 1995 a certain amount of conversion has been implemented at Stepnogorsk through the dismantlement program, international assistance, or independent initiatives. Yet, little commercial success has been recorded so far due to a number of obstacles created both by inherent characteristics of the facility and its region, and by the political context surrounding this conversion.

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[111] As part of the Stepnogorsk conference, foreign participants were to be given a tour of the Biomedpreparat buildings and dismantlement activities. However, on the day of the tour (which followed the disastrous Phase IV negotiations), the tour was cancelled by Biomedpreparat officials. Only by persistent entreaties by the conference organizers and U.S. officials was the tour rescheduled, but foreign participants were only allowed an abbreviated tour and given limited access to the buildings.

1. The AAI Joint Venture: Anatomy of a Failed Project

Conversion of former Soviet weapons facilities is always considered difficult, at times impossible, and yet many facilities have had success stories.[112] So, what led to the failure of this initial defense conversion project at Biomedpreparat? As outlined above, a number of technical and financial problems plagued the project from the outset. To date, most discussions within the academic and government circles tend to focus on these shortcomings. It is true that the technical and financial problems encountered at Stepnogorsk were dire and caused many logistical impediments. A closer examination of the facts, however, reveals a more fundamental reason for the project's failure: conflicting objectives held by Biomedpreparat, Allen & Associates, the U.S. government, and the Kazakh government. These different objectives were an essential, albeit shaky, part of the foundation upon which the project was based. When the foundation began to crumble owing to conflicts among these different objectives, technical and financial problems hastened the project's demise. It is important to examine these factors in greater detail to understand how such an important project—the first U.S. government effort at engaging a major Soviet BW facility—ultimately failed.

a. Technical and Financial Issues

At the outset, the capabilities and condition of the Biomedpreparat facility were not clearly identified or outlined for the project. Prior to the contract award in 1995, no U.S. government official had visited the facility. Because of this, limited information was available regarding the production capabilities, standards, location, and power supplies at Biomedpreparat during the U.S. government contract bid.[113] In spite of this, AAI argues that the U.S. government maintained that the facility was ready and able for pharmaceutical production.[114] Although the reasons that Allen & Associates were chosen for the contract remain controversial, it is clear that the

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[112] For descriptions of former Soviet defense conversion success stories see Sonia Ben Ouagrham, "Approach of Successful Enterprises," in *The Anatomy of Russian Defense Conversion*, p. 630.

[113] In contrast to the Stepnogorsk contract, five potential contractors for conversion of the Ft. Detrick facility were invited to a bidders conference. This meeting included a tour of Ft. Detrick and the release of detailed information on inventory and operating costs of the facility. "Prospective Contractors Sent Cancer Center Applications," *Frederick News-Post*, 12 January 1972.

[114] Dimitar Antonov, AAI, interview by authors, Washington, DC, 27 August 2001.

company came into the project with some limitations.[115] For example, AAI was not a commercial biotechnology company and eventually partnered with ICN pharmaceuticals for technical assistance on the joint venture. It would have been better if AAI had had a proven track record of commercial biotech activities in the Former Soviet Union.[116]

A few months after the contract was awarded, AAI representatives visited the facility. In contrast to their expectations, AAI representatives found it virtually impossible to locate appropriate clean rooms and biosafety/biocontainment equipment where pharmaceutical production could be initiated. Furthermore, Biomedpreparat's financial insolvency led to problems in paying its utility bills, creating intermittent electrical, heating, and water supplies. Heating shortages caused pipes in several buildings to freeze and break, which later led to flooding problems. For example, the infirmary basement was flooded due to a large leak from building 221. Since there was great concern that the flooded waters would have BW contaminants, AAI conducted sampling within the basement and grounds surrounding the infirmary. Fortunately, the sampling did not find any evidence of BW contamination. With these results, AAI proceeded with its plans to use the infirmary for the joint venture, which now necessitated major renovations to pump out the water in the basement, repair the building foundation, and build trenches to protect the building from any future floods. These renovations caused serious delays in the project schedule and incurred additional costs that were not included in the initial project budget and timeline.

[115] John Allen, president of AAI, was a former intelligence agent and Reagan campaign operative. It is alleged that although Allen knew little about pharmaceutical production, he had political connections that helped secure the contract. On the other hand, defense conversion expert David Bernstein comments that the Department of Defense's procurement process was flawed for these early conversion projects. In their initial "Request for Proposals," the Department of Defense stated that the U.S. government would provide cost-sharing funds for the joint venture projects. Bernstein states that advertising the cost-sharing tended to attract companies for the wrong reasons. Many of these companies had no experience working in the former Soviet Union nor did they understand the complexities in the Department of Defense's procurement rules and regulations. See Dobbs, "Soviet-Era Work on Bioweapons Still Worrisome;" David Bernstein, interview with Kathleen M. Vogel, 6 June 2002.

[116] When Ft. Detrick was seeking a contractor for its conversion to a National Cancer Institute, the criteria used for selection involved (in order of decreasing importance): (1) biomedical research capability, (2) science management capability, and (3) business management support and logistics. Litton Bionetics, Inc. was ultimately chosen to operate the center because they had been active as a commercial biological research laboratory for over 10 years and had done a substantial amount of previous contract work for the government. "Prospective Contractors Sent Cancer Center Applications," *Frederick News-Post*; William Graffam, "Bids on Fort Detrick Project, "Confidential," *Frederick News-Post*, 24 March 1972.

In terms of project execution, there were considerable differences of opinion between AAI and Biomedpreparat with respect to the pill presses and packaging lines to be used.[117] Biomedpreparat officials considered the shipment of equipment upon arrival to be second hand and inferior—vintage 1970s era of Yugoslav origin—and in no way suitable for production. Because of this and the lack of documentation or instructions, Biomedpreparat refused the shipment and it remained unpacked for several months.[118] In contrast, AAI insists that state-of-the-art equipment was not needed for the project. Although AAI did not consult with Biomedpreparat before devising the production plan, AAI felt that the equipment they provided was adequate for employee training and project execution, and kept costs low.[119]

During the course of the entire project, Biomedpreparat received only equipment as part of the agreement, not hard currency.[120] Lack of funding added to Biomedpreparat's already difficult financial situation, leading to perpetual problems in paying for electricity service to support the project.[121] A vicious circle therefore resulted between non-payment of utility bills and lack of service. The financial strain on Biomedpreparat caused further sources of conflict, and the relationship between AAI and Biomedpreparat soon disintegrated beyond repair.

At the same time, AAI did not initially take into account how the new political environment could impede commercial activities. When the project started, there was no pharmaceutical distribution system in Kazakhstan. The centralized distribution system that had existed during the Soviet era collapsed after Kazakh independence. In order to remedy this shortcoming, AAI worked with ICN to establish computerized information networks in certain Kazakh regions and

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[117] AAI officials found that some syringe production lines had already been established at Biomedpreparat. Apparently these were established during the Soviet period. Unfortunately, these lines and the syringes produced were of poor quality. Although AAI found a potential market to sell these syringes, Biomedpreparat was not able to make the improvements to the syringe quality necessary for commercial sale. Dimitar Antonov, interview by authors, Washington, DC, 27 August 2001.

[118] "Proshai Oruzhie?" (Bye Bye Weapons?), *Novosti Nedeli*, 10-16 October, p. 6; Vladimir Bugreev, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

[119] Dimitar Antonov, interview by authors, Washington, DC, 27 August 2001.

[120] Gennady Lepyoshkin, interview by authors, Washington, DC, February 2001.

[121] All power at Biomedpreparat ran through Plant Progress. Since Progress also suffered from economic troubles —frequently paying its employees with onions—it was not in a position to help Biomedpreparat. Although AAI had tried to interest other U.S. companies to invest in Plant Progress, not one company responded to the invitation. Dimitar Antonov, interview by authors, Washington, DC, 27 August 2001.

local centers on the Kazakh market. Such an information network could have led to a future distribution system. Unfortunately, this project never materialized. The local person that AAI hired to set up this network, a corrupt Ministry of Health official, charged AAI $50,000 and then disappeared.

Due to the myriad problems, the project was unable to meet deadlines set by the U.S. government. With setbacks due to building renovations and other logistical problems, AAI felt increasingly pressed by the U.S. government to show tangible results for the project. Because of this, AAI decided to go ahead and set up some packaging lines and start some aspects of the project—even among concerns that the products were being packaged improperly or in unsanitary conditions. At the same time, Biomedpreparat officials felt increasingly marginalized, and U.S. government officials became more and more frustrated by the lack of progress on the project.[122] It soon became clear that all parties involved should have conducted a thorough technical and financial evaluation of the facility and the proposed project before entering into a joint venture. In spite of these difficulties, even more important factors were involved in the failure of the project.

b. Conflicting Objectives

At the core, the problems in the conversion project centered on the conflicting objectives of Biomedpreparat, Allen & Associates, the U.S. government, and the Kazakh government. The last two parties were mainly motivated by political objectives, while the first two were driven by economic imperatives. These different objectives created different expectations and approaches to conversion, as well as different conceptions of the role that each party would play in the project. Lack of communication—and at times false communication—between the parties exacerbated these misunderstandings. Over time, these conflicts eventually grew to the point that a successful outcome was not possible.

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[122] Some of these technical delays, however, should have been anticipated from prior U.S. conversion efforts at Fort Detrick. Turning the Fort Detrick BW facility into a National Center for Cancer Research required significant renovations, lasting almost one year. Difficulties in renovations were due to the fact that many of the laboratories had not been in use for at least three years. In some cases, equipment and infrastructure had aged to the point where repair was deemed no longer feasible or economical. Also, new equipment needed to be purchased and changes made in laboratory space to facilitate the new research activities. The cost for these renovations during this period was approximately $3 million (1977 dollars). Milton Leitenberg, personal communication with Kathleen M. Vogel.

Biomedpreparat's main objective was to obtain sufficient funding to support its personnel and maintain the facility. Similar to many former Soviet defense enterprises at the time, Biomedpreparat was primarily focused on short-term results. Given the unstable economic situation that resulted from the ending of Russian financial support to the city and the lack of Kazakh government support for conversion, Biomedpreparat's focus on attracting foreign currency to make short-term profits is understandable. Biomedpreparat also expected AAI to deal with conversion the Soviet way. For instance, AAI would provide the funds and tell Biomedpreparat what to produce and in what quantities; distribution and commercialization would be handled by AAI as well. It is clear, however, that there was a total lack of understanding within Biomedpreparat of basic business and market principles, as well as national and international pharmaceutical production standards. The persistence of Soviet mindsets also favored a technology push approach and resulted in unrealistic expectations on what was feasible for the conversion project.[123]

As a business, Allen & Associate's main interests in the conversion project were profit oriented. In contrast to Biomedpreparat, AAI was focused on reducing costs to maximize profit. This implied a continual reevaluation of the project, its scale, and the time table, which led to a decrease in the funds for Biomedpreparat and delays in product distribution. AAI was not able to examine the facility before the contract was awarded, and the lack of information led to a series of problems and delays. Biomedpreparat and AAI were thrown together without a period of time in which both sides could evaluate one another and determine whether they could work together, to include the development of a workable conversion project. Also, AAI did not understand its contractual obligations or what role the U.S. government would play in the venture, and it failed to realize the underlying political objectives implicit in the government contract.[124]

In contrast to Biomedpreparat and AAI, it appears that the U.S. government was motivated primarily by political objectives. From the beginning, the conversion project with Biomedpreparat was formulated for nonproliferation and defensive purposes. The main objectives of the contract were to learn more about the former Soviet BW activities at the facility, to dismantle the

[123] Technology push is defined here as development or creation of products based on available technologies or capabilities rather than on demand. Products driven by this concept are difficult to get into the marketplace because they usually do not meet customers' needs. Note, however, that most conversion projects developed during this time were primarily technology-push. Both the former Soviet and Western partners overestimated the technological achievements of Soviet defense facilities and their adaptability to the consumer market.

[124] Dimitar Antonov, interview by authors, Washington, DC, 27 August 2001.

facility, and to stem the proliferation of weapons scientists. Economic or business objectives were secondary, and U.S. government officials expected AAI to deal entirely with this aspect. At the time, the U.S. government had a poor understanding of what was involved in conversion of a former Soviet defense facility, which led to the flawed initial project design and contract bid. For example, the joint venture, as originally defined by the U.S. government, did not take into account the context nor the problems involving product distribution. Furthermore, there appears to have been limited U.S. government oversight on the project. With the various disagreements between Biomedpreparat and AAI, it would have been useful to have a more visible U.S. government presence on-site during the execution of the contract. This would have been beneficial not only for mediation purposes, but also to more accurately evaluate the project's progress, and show strong U.S. oversight and commitment to the project.

The value of this project for the Kazakh government was to demonstrate its resolve in eliminating the Soviet BW legacy and supporting nonproliferation policies. However, these objectives did not translate into a coherent policy supporting or facilitating conversion. To the contrary, Kazakh government officials, driven by short-term objectives or personal interest, raised a number of obstacles to the project. The Kazakh Ministry of Health (MOH), which was in charge of all Kazakh pharmaceutical industries, imposed stiff restrictions and fees to import and register pharmaceuticals. The MOH's strategy maximized its ability to collect revenue through these rules and regulations. Although tariffs on imports can be used to promote domestic production, the Kazakh MOH's approach instead served as an obstacle, making it difficult for foreign companies, like AAI, to consider longer-term investment in the Kazakh pharmaceutical industry. At the same time, the government did not provide any additional incentives, such as tax relief or subsidies, to help Biomedpreparat in its conversion efforts.

The bad experience from this initial conversion attempt resulted in many bitter feelings among all the participants. Biomedpreparat officials felt cheated by both AAI and the U.S. government. John Allen, president of AAI, has publicly criticized both the U.S. government and Biomedpreparat for the failure of the project saying, "They had no idea what their needs were. They had never made a pill in their life."[125] At the same time, U.S. government officials blamed

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[125] Dobbs, "Soviet Era Work on Bioweapons Still Worrisome," p. A1.

AAI for its poor management of the project. Resentments run deep for all parties involved in this project.

c. Wrong Approach, Wrong Partner

With conflicting objectives and expectations, technical and financial problems, and no information on the local conditions, it is not surprising that the project failed. Judging by the facts, each party clearly made mistakes but also had to deal with extenuating circumstances. Nevertheless, the failure of this project can be summed up as the choice of a wrong approach to conversion and the choice of the wrong partner.

The choice of AAI as the business partner in this program was one of the main mistakes made by the U.S. government. Before working on this project, AAI had no experience in the commercial pharmaceutical field. This may be one of the reasons why some basic questions regarding Biomedpreparat capabilities were not asked prior to signing the contract. It would have been more appropriate to engage a U.S. enterprise already involved in the pharmaceutical field to identify the possibilities and potential obstacles to a successful conversion at Stepnogorsk. In this context, it is surprising that the U.S. government did not make better use of its experience in conversion at Fort Detrick and Pine Bluff. Due to the lack of first-hand understanding of the requirements of the pharmaceutical field, both AAI and the U.S. government engaged in an unrealistic project and took no account of the local situation—until it was too late.

A comprehensive evaluation of Biomedpreparat capabilities should have been conducted prior to designing the conversion project. A detailed description of the existing infrastructure, including energy supply, the state of the equipment, and the qualified personnel available, could have served as a base to determining the type of product to be produced, the targeted market (domestic or international), and the profile of the U.S. partner needed. Instead, the U.S. government proceeded backwards, by determining first the product, then the partner and the market, before an analysis of the available capabilities had been made. The question remaining now is whether the outcome would have been more successful using a different approach to conversion. Perhaps the inherent structural, economic, and regional characteristics of Stepnogorsk would have still created insurmountable obstacles to conversion. What does the future hold for Biomedpreparat, the IPB, and the Environmental Monitoring Laboratory?

2. Conversion In A New Context

To date, a detailed analysis of the reasons behind the failed 1995-96 AAI conversion attempt has not been made by the parties involved. There has been no attempt to draw important lessons learned from this first experiment. As a consequence, the analysis of infrastructure, equipment, personnel, and technologies available for conversion has not been conducted. A clear description of the obstacles to and potentials for conversion, taking into account the geographic, economic, political and social environment, is also pending. Yet, without a detailed inventory of available resources, and a qualified appreciation of the environment in which conversion has to take place, no conversion strategy can be designed. Instead, conversion becomes a survival maneuver conducted in the dark. Given the numerous changes that have occurred since the break-up of the USSR and the implementation of the U.S.-sponsored dismantlement program, it is important to summarize the conditions under which conversion has to take place today.

a. Resources Available For Conversion

One of the consequences of the break-up of the USSR is that most of the qualified personnel have left the former BW facility. This decreases the burden of converting former BW personnel but also raises the question as to whether the remaining personnel are sufficiently qualified to conduct the appropriate conversion of the facility. This question will be particularly important when it comes to determining the type of civilian activity to select: production vs. research, high-tech vs. low-tech production.

The dismantlement of the former BW production plant and the planned destruction of the three buildings also decrease the burden associated with converting buildings and equipment. We might argue that the loss of equipment and production space compromised early conversion efforts. It is worth noting, however, that the buildings were already damaged when the first conversion program started in 1995, owing to the lack of heating and maintenance after the break-up of the USSR. Their use for civilian production would have required extensive repairs and upgrades. Further, the risk of residual contamination of the buildings would have required decontamination procedures. Therefore, conversion would have needed to take place off-site in the city of Stepnogorsk, using buildings that were never involved in Soviet BW production. As a result, the destruction of the former BW production buildings does not deprive the NCB of a useful resource for conversion.

With most of the equipment destroyed and the buildings dismantled, conversion in Stepnogorsk mostly concerns personnel: former BW personnel still working today at the NCB, as well as other support personnel who also need to be 'converted' since they are still on the NCB's payroll. This constitutes a total of 260 people,[126] with about 40 persons with BW knowledge.[127] They include the deputy directors of the NCB (management entity) and the monitoring laboratory, as well as the scientific teams of these institutions.

Only building 211, the nutrient media production building, remains untouched, and can be converted to civilian use, since no BW activity took place in this building. Remaining dual-use equipment (i.e., research scale fermentors, lyophilizers) has been transferred from Biomedpreparat to the other institutes of the NCB in Stepnogorsk. Therefore, the entities to be involved in conversion are the IPB, the Environment Monitoring Laboratory, and building 211 at Biomedpreparat. The social infrastructure of the NCB has been transferred to the state, decreasing the financial burden on NCB and freeing resources for conversion.[128]

b. Remote Location and Depressed Economy

The city of Stepnogorsk has changed tremendously since the break-up of the USSR. By 2000, its population had decreased from 90,000 in the Soviet time to 40,000 inhabitants.[129] Like Biomedpreparat, other local enterprises have lost a large part of their personnel as a result of the break-up of the Soviet Union and the economic crisis that followed. The local economy is dominated by only a handful of industrial plants, such as a metallurgical plant, the NCB, a bearings plant, a dairy products plant, and a mining company. Due to the poor economic situation, many of these enterprises have sharply decreased their activities and downsized their personnel.[130] Some people have tried to set up small businesses, but this has been rarely successful due to the

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[126] NCB: 40 people, IPB: 70 people, Monitoring Laboratory: 30 people, Biomedpreparat: 120 people.

[127] Gennady Lepyoshkin, interview by authors, Washington, DC, February 2001.

[128] Only the Biokombinat of Almaty still maintains kindergartens and a vacation resort. Gennady Lepyoshkin, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

[129] Nikolai Deninieg, Stepnogorsk Mayor, remarks made in Stepnogorsk, Kazakhstan, 26 July 2000.

[130] "Proshai Orujie-2" (Bye, Bye, Weapons-2), *Novosti Nedeli*, 17-23 October 2000, p. 8.

lack of investors and the poverty of the local population.[131] The city has little infrastructure, poor roadways, and undeveloped utilities. Electricity cuts are frequent, and the city is deprived of hot water or heating for long periods of time. Other infrastructure present during the Soviet time has been closed or sold after the break-up of the USSR: four cinemas (closed), a cultural center (closed), sports center (sold), two shopping centers (one closed), airport (closed), bus and train stations (closed).[132]

This situation has reinforced the geographic isolation of the city, which in turn has inflated the consequences of the local economic crisis.[133] Many believe that the city's isolation might be broken by the relocation of the nation's capital to Astana, a city located three hours south of Stepnogorsk. As Astana grows, it may contribute to the renewal of Stepnogorsk and help the conversion of the NCB. Yet, Astana is still underdeveloped, consisting mostly of a few administrative buildings and shopping centers. Economic activity has not yet flourished in the capital. The territory between the two cities is mostly composed of long stretches of steppes, with only a few villages in between. Any positive effects related to the relocation of the capital won't be manifested for several years.

Thus, since the break-up of the USSR, the changes in the facility's structure and in the economic and geographic environment in Stepnogorsk have generated a strange mixture of characteristics. These changes have led to some relief in the scale of conversion required, but have also introduced greater difficulties in the conversion process due to the depressed state of the local economy. In addition, there are other factors that we need to take into account to fully appreciate the complexity of the conversion process in Stepnogorsk.

3. Obstacles To Conversion In Stepnogorsk

a. Legal Status

The NCB is a state facility, which implies that its conversion plans must be approved and sometimes even initiated by the Kazakh government. The law on conversion of Kazakhstan states that the Cabinet of Ministers determines the list of converting enterprises and approves

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[131] Gennady Lepyoshkin, interview with Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

[132] "Kuda uekhal tsirk?" (Where Did the Circus Go?), *Novosti Nedeli*, 21-27 October 2000, p. 12.

[133] Ibid., p. 12.

their conversion plans. Although a state-owned status allows very little flexibility in strategic planning or cooperation with foreign partners, these difficulties can be overcome by good cooperation and communication with government officials. However, this is a great challenge in Kazakhstan due to the peculiarities of political life. Concentration of power in the hands of the President and a high rate of government turnovers hinder long-term support for projects, unless it is a priority determined by the President. Unfortunately, the facts show that conversion of former BW facilities does not rank high in the Presidential agenda.

Since its inception in 1993, the NCB has been transferred under the administrative control of three ministries (Ministry of Science and New Technologies, Ministry of Science and Education, Ministry of Energy, Industry, and Commerce) and one government agency (the Health Agency under the Ministry of Education and Science). More recently, after the elimination of the Health Agency in early 2001, the NCB has been transferred under the direct control of the Ministry of Science and Education (see Figures 4 and 5). In addition to causing damaging disruptions in project implementation, these repeated changes in administrative control require high investments of time by the NCB's management to establish an adequate communication with the new government officials involved, generate their interest in the NCB's conversion, and instill in them the institutional memory that they are lacking.

Frequent changes in administrative control over the NCB have also introduced additional disruptions in the Center's management. Until 2000, the NCB's management was able to convince government officials of the importance of its projects. However, since the government reshuffle of March 2001 and the ensuing transfer of the NCB to the control of the Ministry of Education and Science, communication has been more difficult. Dr. Lepyoshkin was fired and was replaced by Dr. Sergazy Adikenov, a chemist by training, who headed the Institute of Phytochemistry in Karaganda. Dr. Adikenov shows little interest in conducting conversion at Stepnogorsk. As mentioned earlier, he is more interested in moving the Environmental Monitoring Laboratory to his hometown of Karaganda and has proposed establishing a new national laboratory there to develop anti-cancer drugs.[134] In addition, the new director has already replaced some of the existing weapons scientists on U.S. and internationally sponsored research projects with his

[134] U.S. government official, interview by authors, May 2001; U.S. government official, interview by authors, Springfield, VA, 1 November 2001; U.S. government official, interview by authors, Washington, DC, 20 August 2001.

own scientific personnel and is attempting to restructure some of these ongoing scientific projects. U.S. government officials express concern with these actions and are conducting reviews of their existing projects. As of December 2002, it is still unknown what effects these personnel and organizational changes will have on the dismantlement project or on other redirection efforts.

b. Lack of State Support

One consequence of the regular government reshufflings and high turnover in government personnel is the lack of coherent state policy and support in the conversion process. For instance, in its early efforts at conversion, the NCB management had proposed producing insulin as a conversion project. In order to finance production, the NCB had applied for a loan at the Barclays Bank which the state originally planned to guarantee. However, when the loan was awarded, the government unexpectedly changed its policy and decided not to guarantee bank loans any more.[135] As a consequence, the NCB lost the loan and conversion based on insulin production could not take place.

Similarly, in 1995 a state program, on "The Use of Genetics for Agriculture, Health and Industry," was developed by the NCB to promote the technological and production capabilities of its member organizations, and meet national needs in the field of genetics, agriculture and industry. The program was approved by the government in 1995 for a five-year period (1995-2000) and renewed for 5 more years in 2000 (2000-2005). Originally, this program aimed to benefit the members of the NCB by providing them regular state funding. However, funding was very low from the very beginning. In the first year only $300,000 was set aside, and then the funding ran out.[136] More recently, a tender system has been introduced. The state program is now published and any enterprise in the country—civilian and former BW facilities—can submit its project proposals.[137] In theory, projects are chosen on a merit basis. Some people, however, believe that funds are awarded on the basis of personal ties or preferences. In the aftermath of the recent reorganization, the NCB has lost its priority status in the government, and therefore one of its main sources of funding for conversion. On the other hand, the local Stepnogorsk authorities

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[135] Gennady Lepyoshkin, interview by authors, Washington, DC, February 2001.

[136] Vladimir Bugreev, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

[137] Gennady Lepyoshkin, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

are supportive and maintain good relationships with the NCB's management. Yet, the local economy is dependent on facilities that have tremendous economic difficulties, including the NCB. As a result, the local administration does not have sufficient means to support conversion.

c. Lack of Finance and a Difficult Economic Situation

The NCB is a state facility, and it implements state orders, but it is only partly financed by the state budget. In 1999, only 38 percent of its total budget came from state funds. As shown in Table 4 below, most of the NCB's income is generated by foreign assistance and commercial activities.[138] The percentage of state funding in the total budget has decreased dramatically since the break-up of the Soviet Union. Therefore, the high percentage of outside funds in the NCB's total budget is misleading. It does not indicate the generation of high income from commercial activities or international assistance; rather, it is the regular decrease of State funding since 1994 that has inflated the share of outside funds in the NCB's budget.

Table 4: 1999 Budget Finances of the NCB (in thousands of Tenge)[*]

NCB Entity	State Funding	State Program for Fundamental Research	International Grants	Own Production and Services	Total	% of State Budget in Total
IPB	918.0	0.0	10,160.1	1834.0	21,174.1	43.4
IPPGB	12,678.0	2966.0	5936.0	0.0	21,580.0	72.5
NISKII	12,106.3	200.0	5754.0	52,300.0	70,360.3	17.5
CLMC	3048.9	162.5	0.0	0.0	3211.4	100.0
Biokombinant	267.0	0.0	0.0	45,442.0	45,709.0	0.6
National Biocenter	8315.0	0.0	560.1	2847.0	11,722.1	70.9
AO Biomed-preparat	0.0	0.0	89,237.3	11,883.9	101,121.2	0.0
AOOT Biopreparat	0.0	0.0	0.0	220,678.0	220,678.0	0.0
Total	45,595.2	3328.5	111,647.5	334,984.9	495,556.1	38.1[†]

[*]Information provided by Gennady Lepyoshkin, April 2000; $1 = 145 Kazakh Tenge (KT)
[†]This figure is an average for all eight institutes listed in this column.

[138] Ibid.

The members of the NCB are not equally affected by the decreasing state budget. Typically, the facilities mainly involved in research are better off than those involved in production.[139] Scientific research institutes of the NCB are more or less financed by state programs, and they have a smaller workforce than the production facilities. In contrast, production facilities must try to survive on their meager commercial income. Among the members of the NCB experiencing the greatest financial difficulties are Biokombinat (Almaty) and the Otar facility. The former faces Russian competition on the Kazakh market for animal vaccines, while the latter has a large production infrastructure and significant overheads. Biomedpreparat, on the other hand, has a more favorable situation due to CTR program support.[140] The IPB is in a similar situation. In 1995, the institute depended 100 percent on the State budget, while in 2000 only 40 percent of its budget originated from the state, with 60 percent generated by its commercial activity and international assistance programs. For example, 30 percent of the 1999 IPB budget was generated by two projects in the framework of the U.S. Department of Energy's Initiatives for Proliferation Prevention program.[141] Unfortunately, international assistance is usually only sufficient to pay debts and utilities bills. Typically, very little is left to support other conversion projects or pay late salaries.

The average salary within the NCB ranges from $50 to $75 a month (approx. KT 7000-11,000).[142] The average salary of scientific personnel is about $75/month (approx. KT 11,000).[143] Due to delays in state funding, wage arrears are very common at the NCB. For example, in April 2000, the employees had not been paid for three months. At the Otar facility, as of April 2001, salaries had not been paid by for six months.[144] According to Dr. Lepyoshkin, about 120 people in Stepnogorsk—including scientists, laboratory employees, and technicians—participate in international assistance programs. Contrary to popular belief, these programs provide only a

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[139] Ibid.

[140] Ibid.

[141] Vladimir Bugreev, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

[142] Gennady Lepyoshkin, interview by authors, Washington, DC, February 2001.

[143] Ibid.

[144] Segadippar Mamadaliev, interview by authors, Almaty, Kazakhstan, April 2001.

portion of the scientists' regular salaries. This assistance money is received after completion of work according to contract specifications, a process that can take several months. As a result, personnel receive international assistance, on average, once every three months. A highly qualified scientist like Dr. Lepyoshkin receives approximately $200 every three months from ongoing assistance programs.[145] This money serves as a bonus to his existing salary.[146] During delays in U.S. government assistance, these scientists have to live on their existing salaries, which, as mentioned above, suffer long arrears.

d. Lack Of Market Knowledge And Market Information

Each member organization of the NCB has created a commercial department for market research.[147] Thus far, this activity has been unsuccessful since the personnel have no knowledge of marketing techniques. This is not very surprising since they have received no formal training in market principles. They also lack commercial information, as there are no organizations in Kazakhstan that can collect, check, and guarantee this type of information. In this context, it is very difficult to identify future needs or the status of competition, and to determine new activities for conversion.[148] Conducting conversion in such conditions is akin to a beginner playing darts in the dark. The beginner's dart may eventually hit the target after many attempts, but only by chance. Given his inexperience, the player might not realize that the target was hit.

e. Persistence Of Soviet Mindsets

When asked the question, "what is the key measure that needs to be taken in order to set in motion a series of events that would allow conversion to go smoothly and achieve successful results," NCB representatives responded that more funds should be devoted to conversion. Training of personnel in marketing and other basic knowledge of market economy were not consid-

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[145] International assistance programs pay salaries of $50 to $400 per month for work on research projects. The amount of money that a scientist receives depends on his position, the percentage of time devoted to the project, as well as an adjustment for the local cost of living.

[146] Gennady Lepyoshkin, interview by authors, Washington, DC, February 2001.

[147] A "department," however, may consist of only one person.

[148] Gennady Lepyoshkin, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

ered as vital elements. Nor did they mention the difficulties due to the location.[149] This reveals a typical Soviet mindset, by which the volume of resources devoted to production is the main criterion to measure success.

In a related manner, the NCB's management also tends to develop large-scale projects and dismiss the value of smaller scale projects. For instance, during the July 2000 Stepnogorsk conference, the presentations and comments revealed that the U.S. and NIS participants had very different evaluations and expectations of foreign assistance programs at Stepnogorsk. Western participants believed that although the projects (described below) were not sufficient to ensure the long-term survival of the facility, they represented a base that could be further developed as the facility better understood the needs of the local and national markets. NIS participants on the other hand, expected western representatives to provide ready answers to their problems, i.e., projects that could be started and bear tangible returns immediately. Other evidence of the persistence of Soviet mindsets is shown in the number of administrative personnel handling the dismantlement contract at Stepnogorsk. Of 120 personnel employed in the dismantlement project, approximately sixty percent are administrative staff. This is obviously an excessive personnel capacity.[150] Yet, considering the isolation of the city, the lack of contact with foreign investors, and the lack of market education and information, it is not surprising that Soviet mindsets have persisted.

f. Unfavorable Environment

The factors described above create a general context that is unfavorable for conversion. Certain constraints are attached to the NCB's state-owned status. These include its dependence on the state for funding and decision-making, and the regular unexpected changes in its administrative dependence due to government reshufflings. These characteristics have generated a high level of uncertainty that blocks the NCB management's ability to make strategic decisions and plan for the long term. The limitations of the local economy deprive the NCB from developing a two-way strategy: exploring activities that meet local demands to ensure its immediate survival,

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[149] Gennady Lepyoshkin, interview by authors, Washington, DC, February 2001; Vladimir Bugreev, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

[150] U.S. government official, interview by authors, June 2001.

while also designing other activities for the longer term. The lack of market education and information coupled to the lack of market institutions imply that no clear conversion strategy can be made. If by chance a niche is found, expansion of production and market share will be also very difficult. Finally, the characteristics of the local economy and the persistence of Soviet mindset scare foreign investors away, making conversion more dependent on state funding or international assistance programs and the local, untrained management. In other words, with no decision-making ability, no funds, no market education and information, and in a depressed economy, it is an understatement that Stepnogorsk is not a favorable environment for conversion.

This does not mean, however, that conversion is not possible. The ability of the NCB's management to conduct conversion will depend on their ability to overcome these difficulties. This will involve introducing more certainty to their environment, reclaiming their decision-making ability, finding alternative sources of funding, and becoming acquainted with the market. This might seem a Herculean task. However, other Soviet defense facilities have gone through the same difficulties and eventually succeeded in their conversion efforts. Further, the resources at hand, such as highly qualified personnel and other support labor and equipment at the Environmental Monitoring Laboratory, the IPB, and building 211, allow the NCB to contemplate a conversion based on both research and production.

If, however, the conditions remain unchanged, it is probable that conversion will be directed towards a "known terrain," i.e., dual-use technologies and/or the intensification of former civilian production. This strategy will absorb the few resources available without bringing any return. Owing to the uncertainty of the environment, it is probable that projects will be essentially short-term and aimed at ensuring the survival of the facility rather than meeting a market demand.[151]

4. On-going Conversion Projects At Stepnogorsk

In spite of the numerous obstacles described above, some conversion is actually taking place in Stepnogorsk. So far, however, it has been the result of, or supported by, international assistance and to a certain extent by dismantlement. These assistance programs primarily con-

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[151] In an uncertain environment it is more coherent to make short-term plans in order to conserve some type of flexibility and more easily adapt to changes.

centrate on former BW scientists of the IPB and the Monitoring Laboratory, as well as some members of the NCB (management entity) and Biomedpreparat. However important these projects may be, they are all primarily short-term projects, aimed at employing former BW scientists to curb proliferation of BW knowledge. Although some of these projects provide instruments that will have a longer-term use and will help support conversion in the long run, most of them have allowed the redirection of production resources to civilian use without supporting commercialization. None of these programs have allowed a true economic conversion, i.e., the creation of civilian activities that generate profits and transform former behaviors and mindsets. To date, the independent attempts at conversion made by the various institutes of the NCB have been rather unsuccessful. Yet, some of them have a clear market potential.

a. Conversion Aspect of Dismantlement[152]

In spite of the fact that conversion was not designed into the dismantlement program,[153] we have identified different aspects of the dismantlement and redirection processes that can be indeed considered as an indirect conversion of production resources. One of the main conversion results of the dismantlement is the reemployment of former employees of Biomedpreparat and the creation of new jobs for Stepnogorsk inhabitants who were unemployed.[154] According to Mr. Rufov, Director of Biomedpreparat, the dismantlement work occupies a total of 120 people, of which twenty are former engineers of Biomedpreparat and the others are laborers.[155] Those personnel employed in dismantlement activities receive an average salary of $180 a month while the average salary in the Stepnogorsk region is less than $40 a month (Kazakh Tenge 5800). The

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[152] If not otherwise stated, the information in this section is based on presentations given at the conference on "Former Biological Weapon Facilities: Dismantlement and Prospects for Conversion," Stepnogorsk, Kazakhstan, 24-26 July 2000.

[153] As stated previously, the dismantlement project at Stepnogorsk was pursued after conversion had failed and was not specifically designed and implemented to promote conversion. Dismantlement was undertaken solely to remove the offensive and proliferation threats of the facility. However, in spite of this, the Department of Defense did not hinder Biomedpreparat officials from continuing conversion efforts on their own and were open to the prospect of revisiting a new conversion plan in the future. For example, the large-scale fermentors in building 221 were not included in the initial dismantlement contract because Biomedpreparat hoped to use them in commercial production. See note 95.

[154] Note that the NCB can employ only Kazakh citizens.

[155] Gennady Lepyoshkin, interview by authors, Washington, DC, February 2001.

dismantlement contract also covers the salaries of administrative employees of the NCB who are involved in the management of the contract.

Dismantlement work also supports the activities of the Environment Monitoring Laboratory. The Laboratory was established to assist with the dismantlement work, with $1.2 million support from CTR program. It has performed more than 15,000 analyses of samples taken in the buildings, as well as samples of land, air, and vegetation taken around the buildings. Further, the operating expenses of the monitoring laboratory ($55,000 per year), including the salaries of its personnel, are totally covered by the dismantlement contract.

Dismantlement has also allowed some conversion of equipment. Some laboratory equipment that was formerly used by Biomedpreparat has been transferred to the IPB instead of being destroyed. This includes small-scale fermentors and lyophilizers that were not formerly used for weapons purposes. The scrap metal generated by the dismantlement work (iron, stainless steel, and copper) can also be sold by the NCB. According to the facility's representatives, however, the NCB has not derived much profit from this activity.

In addition, dismantlement will indirectly support conversion by providing energy resources. The power stations purchased to facilitate the dismantlement work will remain as assets that can be reused for other purposes after the completion of the dismantlement. Therefore, even though significant equipment and infrastructure have been destroyed in the dismantlement, other resources have been acquired as part of the dismantlement contract which could be used for peaceful, profitable purposes. Dismantlement also provides direct support to other local enterprises. For example, the dismantlement contract covers the purchase of dairy products for dismantlement employees, as well as the cost of transporting employees to and from the dismantlement area in buses that are rented for that purpose.

b. Conversion Programs Supported By International Assistance

Most of the assistance programs for conversion or redirection have concentrated on the IPB and the Monitoring Laboratory and their personnel. The NCB (management entity) has also received some funding. These programs have primarily involved U.S. government assistance (see Table 5).

Table 5: U.S. Nonproliferation Assistance for Former Bioweapons Scientists in Stepnogorsk, Kazakhstan*

Institute	Collaborators	Funder	Status	Length/Funding	Project Description
Institute of Pharmaceutical Biotechnology	None	ISTC, #K-170	Completed	6 months/$20,000	Project Development Grant: To develop a reliable method under laboratory conditions for microorganism cultivation under industrial conditions based on parameters within bioreactors
	Kazakh National Technical University (Almaty) is lead institute on this project	ISTC, #K-464d	Project approved for project development grant	6 months/$30,000	Project Development Grant: Processing of arsenic-bearing ores: development of environmentally friendly technology for remediation of arsenic into a low toxic form that is suitable for long-term storage and burial.
	Pacific Northwest National Laboratory (PNNL); Institute of Microbiology and Virology (Almaty)	DOE/IPP	Ongoing	$320,000 (37.5% goes to PNNL)	Roseofiringi: Use of novel fungi as a topical application for bacterial infections, rashes
National Center For Biotechnology	Pacific Northwest National Laboratory (PNNL)	DOE/IPP	Ongoing	$400,000 (37.5% goes to PNNL)	Use of Beta Carotene in fungal fermentation as a food additive in the agricultural/food industry
	Pacific Northwest National Laboratory (PNNL)	DOE/IPP	Ongoing	$350,000 (37.5% goes to PNNL)	Phytoremediation: Use of native Kazakhstani plants to uptake heavy metals from contaminated soils for environmentally friendly remediation
	Physico-Technical Institute (Almaty), Institute of Ionosphere (Almaty)	ISTC, K-#470	Submitted to ISTC parties for board decision	36 months/$300,000	The Creation of Theory of Human's Health Dynamic Norm in Conditions of Changing Environment and Formation of Individual Nutrition Ration
	Institute of Horticulture and Viticulture (Lead Institute)	ISTC, K-428	Approved, with funding	36 months/$330,000	Preservation of germplasm of fruit, berry cultures and grapes in Kazakhstan

Table 5: U.S. Nonproliferation Assistance for Former Bioweapons Scientists in Stepnogorsk, Kazakhstan (continued)

Biomedpreparat/ Environmental Monitoring Laboratory	EPA, Lawrence Berkeley National Laboratory	ISTC, #K-338	Ongoing	24 months/$650,000	Development of environmental monitoring laboratory
	Institute of Plant Physiology, Genetics, and Bioengineering (Almaty) is the lead institute; Akmolinsky Agrarian University	ISTC, #K-750	Registered, processed by ISTC secretariat (under review)	36 months/$260,000	Phytoremediation of Kazakhstan soils that have been contaminated by pesticides
	Kazakh Research Institute of Fruit Growing and Viticulture	ISTC, #K-423	Approved without funding	36 months/$260,000	Invention of uncovered grape cultivation system in Kazakhstan based on using new cold resistant types and new biotechnology methods of reproduction and growth
	Kazakh Scientific and Research Institute for Environmental and Climate Monitoring (Lead Institute); Scientific Agricultural Research Institute (Otar), USDA	ISTC, K-#444	Approved, with funding	36 months/$230,000	Studying effects of pollutants, environmental conditions, and disease on wheat production in Kazakhstan

* Information provided by International Science and Technology Center (ISTC) database located at: http://www.istc.ru; U.S. State Department official, interview by Kathleen M. Vogel, 18 October 2001; U.S. Department of Agriculture official, personal communication to Kathleen M. Vogel, 21 November 2001.

Research scale fermentor used in the production of an antibiotic, “roseofungin,” by the IPB. This fermentor, originally used in non-BW activities during the Soviet period, was brought over to the IPB from Biomedpreparat. The development of this antibiotic for commercial sale is currently being supported through a Department of Energy IIPP grant.

Early support for the NCB was provided by the International Science and Technology Center (ISTC), as well as the Initiatives for Proliferation Prevention (IPP) Program of the U.S. Department of Energy. Both projects focused on upgrading the communication systems within the NCB and between its members. In 1997, IPP helped set up a telecommunications system at Stepnogorsk. This project was initially designed by IPP to include set up of internet/email access and up to one year of technical and financial assistance. The cost of maintaining the service, however, turned out to be extremely expensive—about $4000 per month.[156] Due to financial difficulties, Biomedpreparat was unable to pay for continuing Internet connection and the service was terminated. In 2000, however, the Center signed a contract with a new carrier at the cost of $1000 per month. In addition, the ISTC has undertaken a project to develop telecommunications among all of the NCB institutes. Although these are not conversion programs per se, an improved communication system will help develop and support future conversion efforts and break some of the isolation of these facilities.

The Environment Monitoring Laboratory cooperates with the Environmental Protection Agency (EPA) to develop its laboratory capabilities. Although primarily initiated to support dismantlement activities, the collaboration is designed to also support redirection efforts. This work was financed by a two-year ISTC grant of $650,000 awarded in April 2000. This project has three objectives: (1) to set up additional laboratory equipment (atomic absorption, high pressure liquid chromatography, mass spectrometry) and train personnel in analytical methodologies, (2) to evaluate contamination in the Stepnogorsk area,[157] and (3) to assist the laboratory to attain national and international laboratory accreditation. In addition, the project has been designed to provide assistance in the development of a business plan, marketing brochures, and introduction

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[156] Information gathered from visit to Stepnogorsk by Sonia Ben Ouagrham in April 2000 with a U.S. Department of Defense delegation.

[157] These studies involve analyzing pesticide contamination of the area around Stepnogorsk (Lake Alkazor), as well as drinking water and river contamination in the Aksu river. The results of this study will be distributed to the Ministry of Health of Kazakhstan, the ministry of the Environment, regional and city authorities. In addition to receiving in-country training for these projects, Kazakh scientists have traveled to the U.S. to receive additional specialized training. Recently, the EPA has started three new projects with ISTC funding at Stepnogorsk (see Table 5). These are to study (1) the anti-carcinogenic effects of lactobacillus bacteria to determine whether it could be used as a food supplement; (2) remediation technologies for mercury contamination in the area; and (3) pesticide contamination of the grounds around Stepnogorsk and using novel biological organisms as remediation tools. These projects involve not only the Environmental Monitoring Laboratory, but also scientists from the Institute of Pharmaceutical Biotechnology, the Institute of Microbiology and Virology (Almaty), and the Institute of Genetics (Almaty). U.S. government official, interview by authors, Washington, DC, 21 February 2001.

to potential clients (business, government, oil companies).[158] In the longer term, this program should allow the laboratory to develop its clientele beyond Stepnogorsk to cover other regions of Kazakhstan and the NIS.

Former bioweaponeers in the IPB receive support from three IPP research projects in collaboration with Pacific Northwest National Laboratory (PNNL).[159] In the first project, the IPB has developed a new antibiotic called "Roseofungin." This project originated from an idea suggested by the IPB to conduct basic research on a unique strain in their existing collection. The IPP is currently evaluating the project for patent consideration. If successful, the project will enter into consideration for commercialization, although the IPB has sold its rights on this product for $175,000.[160] The second IPP project involves research using fungal fermentation to produce Beta-carotene. The Beta-carotene would be used as a food additive for products in the local agricultural/food industry.[161] A third IPP project deals with phytoremediation. This project will analyze unique Kazakh plants that can absorb metals in contaminated soils. Progress on these projects was slowed by delays in receiving tax-exempt status on IPP funding via a new U.S.-Kazakh government-to-government agreement. This situation delayed funding on all of these projects for one full year. The IPB also receives ISTC funding, consisting of two small grants for scientific project development (see Table 5).

c. Independent Conversion Initiatives

In addition to conversion efforts influenced by foreign assistance or disarmament work, the NCB has also tried to develop independent conversion projects. The NCB management has plans to convert the former media nutrient production building (building 211) for the production of motor oil additives. The project cost is estimated at $300,000. At present, motor oil additives

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[158] Elizabeth George, "Cooperation between U.S. Environmental Protection Agency and Monitoring Laboratory in Stepnogorsk" (presentation at conference on "Former Biological Weapon Facilities: Dismantlement and Prospects for Conversion," Stepnogorsk, Kazakhstan, 25 July 2000).

[159] Two U.S. government officials, telephone interview by Kathleen M. Vogel, 8 August 2001.

[160] According to this agreement, any profits from the sale of this antibiotic in Kazakhstan will go directly to the IPB; any profits made from the sale of this antibiotic outside Kazakhstan will go to the U.S. company.

[161] Vladimir Bugreev, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000. Beta-carotene is a precursor of Vitamin A and has anti-oxidant properties.

are imported from Russia by Shell Oil Company to sell on the Kazakh market.[162] The NCB management has tried to involve a U.S. partner in this venture, without success. The NCB is now contemplating a cooperation with a Russian company to implement that project.[163]

The IPB has also developed several products for the domestic pharmaceutical and food industry (see Table 6). For instance, the IPB has developed new enzymes that can increase the quality of kefir (fermented milk), whipping cream, yogurt, bread, and other food products. These items are staples in the Kazakh and Russian diet. Microbial agents that can improve their quality and taste are likely to have market potential. In collaboration with a research institute in Novosibirsk, the IPB has also developed a drug called "aspinat" (aspirin + natrin). They are now looking for funds to initiate production.[164]

d. Evaluation Of Current Conversion Projects

Successful conversion in the former Soviet Union encompasses two kinds of adjustment (see Appendix). Technical conversion consists of the redirection of buildings, technologies, and knowledge towards civilian activities. Economic conversion involves a significant change in behavior to allow for operating in a market environment. This involves the design of a clear strategy for a period of at least five years that would include: (1) a restructuring of the facility in order to eliminate unused resources (buildings, personnel, equipment) and decrease the cost of future activities, and (2) development of market research to evaluate the ability of the facility to meet a real demand using its available resources. This in turn implies that personnel, and more particularly the management, understand the basic principles of the market. It also presupposes the existence of a market.

Judging by the description of the various conversion projects at Stepnogorsk, conversion has clearly taken place at the technical level. New civilian activities have been identified to coherently exploit the dual-use capability of personnel, their knowledge, the equipment and buildings. On the other hand, economic conversion has not taken place. It is true that dismantlement

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[162] Gennady Lepyoshkin, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

[163] Gennady Lepyoshkin, interview by authors, Washington, DC, February 2001.

[164] The development of these new products was initially financed by a state program to develop biotechnology. However, funds very quickly ran out. Vladimir Bugreev, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

has generated a certain amount of restructuring by eliminating buildings and equipment that cannot be used for civilian purposes. If kept, they would have represented a financial burden to the facility (i.e., cost of maintenance, taxes). However, this restructuring has been imposed by circumstance. It is not the result of a well-planned strategy: NCB management has been reactive rather than proactive in planning for commercialization activities.

Table 6: Products for Sale at the Institute of Pharmaceutical Biotechnology (as of July 2000)*

Description	Use
Drugs	
Imozimasa, 10 ml (ointment) 90g tubes (toothpaste)	Treatment of purulent, necrotic processes, infected wounds, frostbite, stomatitis, dental caries, peridontitis; endometritis, laryngitis, pneumonia, reduces inflammation and stimulates regeneration processes; Active ingredient: imozimasa
Dextranase, 90 g tubes	Toothpaste for cavity prevention; Active ingredient: dextranase
Homeopathic oat tincture, 250 ml	Radionuclides release,treatment for anemia, insomnia, pharyngitis, tonsillitis, dry cough, prevention of influenza and acute respiratory diseases; Active ingredient: flavonoids
Alcohol 5% iodine solution, 20 ml	Antiseptic
1% Antiseptic solution of brilliant green, 10 ml	Antiseptic
Hydrogen peroxide solution, 40 ml	Antiseptic
Food Supplements	
Bifidumbacterin starter, 10 ml	Production of therapeutic-preventative fermented dairy products
Bread (wheat) starter, 10 ml	Prevents dough "potato" disease caused by *Bacillus subtilis* and *Bacillus mesentericus*; reduces dough fermentation period; improves bread taste and flavor; Active ingredient: lactic acid bacteria strains L.fermenti-27 and L. plantarum-149
Sour Cream starter, 10 ml	Sour cream production on the basis of cow milk
Tablets at the Stage of Registration	
Aspinat No. 20	Nesteroid anti-inflammation and cooling medicine; Active ingredient: 2-(Acetoxi) benzoic acid
2% Roseostein ointment, 30 ml	Anti-fungal drug for treatment of all mycotic diseases; effective anti-candidosis drug. For external use; Active ingredient: polene anti-fungal antibiotic roseofungin

* Information provided by Vladimir Bugreev, July 2000

Similarly, the choice of conversion projects in most cases has been imposed by circumstance. For instance, IPB projects conducted under the IPP umbrella are based on ideas developed in the Soviet time to serve as cover stories for BW activities (i.e., beta-carotene and roseofungin).[165] In essence, these projects had no market basis and it is not clear today whether the IPP will be able to launch the commercialization phase. The other projects sponsored by international assistance have been generated through the dismantlement project, and their beneficial effect will stop as soon as dismantlement is completed. This includes the employment of local labor in dismantlement activities and other related support (e.g., transportation, dairy products), as well as the Environmental Monitoring Laboratory. In particular, the Laboratory is more dependent on this short-term financial support as the dismantlement program covers its operating expenses. Further, IPP and ISTC programs usually last three years and do not necessarily lead to a commercial outcome. So far, very few IPP projects with former BW institutes have gone beyond the research stage.[166] In other words, conversion at Stepnogorsk is composed of separate pieces of unrelated activities, which do not constitute a coherent strategy.

No significant change in behavior by Stepnogorsk management took place in the course of the conversion process from 1993 to the present. The projects developed independently by IPB and the NCB (building 211) are primarily technology-push. Some of them have identified market opportunities (i.e., lack of domestic oil additives, improvement of popular dairy products). Yet, these projects have not been supported by a study demonstrating that these products actually respond to a potential demand, i.e., that there is an interest from targeted producers or customers to actually switch to such new products. Nor have they determined what would be the cost of developing the products and introducing them on the market, or what would be the time frame for achieving profitability. Further, these products do not at present provide profits to the NCB, since payments are usually made with barter or not made at all.[167]

The lack of economic conversion was to be expected, owing to: (1) the lack of market infrastructure in Kazakhstan (i.e., no developed banking system, chambers of commerce providing reliable commercial information, or reliable and non-expensive communication systems); (2) the lack of market education among employees of the NCB; and (3) the uncertainty imposed by the

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[165] Ken Alibek, interview by authors, Manassas, VA, 22 August 2001.

[166] One former IPP project with a former Soviet BW institute, "Nematode Biocontrol Agent for Agriculture," is projected for commercialization in 2003-2004. This project involves Pacific Northwest National Laboratory, the State Research Center for Virology and Biotechnology (VECTOR) in Russia, and the California based company AgraQuest, Inc. See United States Industry Coalition, Inc., *Commercial Partnerships in the Former Soviet Union* (Arlington, VA: United States Industry Coalition, Inc., July 2001).

[167] Gennady Lepyoshkin, interview by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

regular reshufflings in the government and the remoteness of the city, which did not allow the market to reach Stepnogorsk. It is clear that with no market economy there cannot be any conversion at the economic level. In these conditions it would have been very surprising if conversion actually had happened on the economic level in Stepnogorsk. Nonetheless, should we conclude that, owing to the characteristics described above, conversion is impossible in Stepnogorsk?

Some would argue that it would be more cost-effective to provide the small number of remaining bioweaponeers at Stepnogorsk (about 40) with: (1) an option for early retirement, with a lifetime pension, or (2) assistance to relocate to a more job-friendly environment. At face value, these options appear to be more simple and economical than trying to support conversion at Stepnogorsk. Yet, there are drawbacks with these approaches that involve cost, political issues, and proliferation risks.

In terms of cost, even the small number of bioweaponeers at Stepnogorsk can incur significant lifetime costs under a retirement plan. Most of these former bioweaponeers are 40-50 years old. Given that life expectancy in Kazakhstan is approximately 65 years,[168] this means that retirement support for these bioweaponeers would need to cover 15-20+ years. On the other hand, supporting these bioweaponeers to relocate to a more dynamic city, such as Almaty, would involve costs of moving the bioweaponeers plus their families, providing a housing allowance (or buying a new apartment) for them, well as providing some temporary financial assistance while they look for new employment. However, if they are unable to find alternative employment, then these scientists would need additional support until they are able to become self-sufficient.

Although, theoretically speaking, both of these options could be supported on a financial level, they would be difficult to support on a political level. It is clear from examining the history of U.S. government assistance that foreign aid programs are not politically viable. In particular, given the recent U.S. economic downturn, it is unlikely that Americans would support U.S. taxpayer dollars going to Kazakhstan to support housing and jobs for Kazakh citizens. Therefore, it is useless to consider U.S. assistance for retirement support or relocation funds as a realistic option.

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[168] World Health Organization, *Highlights on Health in Kazakhstan*, 1999, http://www.who.dk/document/E72497.pdf.

Perhaps more important, however, both the retirement and relocation options carry their own proliferation risks. For example, if there is no reliable way to monitor the activities and movement of retired or relocated bioweaponeers, it would be difficult to ensure that they are not engaging in proliferant activities. This is a problem particularly in Kazakhstan and other Central Asian countries that have open borders, where bioweaponeers and illicit businessmen can move about freely. Because of this reality, the options of retirement and relocation are not a panacea for the proliferation dangers posed by these bioweaponeers. As a caveat, however, it would be possible to envision support of relocation activities coupled with a new commercial or research activity that would be designed with conversion in mind. Conversion of these scientists to new activities that can provide them with long-term economic self-sustainability is the only way to address the brain drain proliferation threat. In the following section, we will describe some potential strategies that could be pursued to support a new conversion effort with Stepnogorsk bioweaponeers.

IV. STRATEGIES FOR CONVERSION

Analyzing the Biomedpreparat BW production facility has helped us to identify a number of key principles governing conversion of BW facilities. These principles are not necessarily new. In fact, some of them were applied to conversion efforts at the Fort Detrick facility in the early 1970s. At the same time, the Biomedpreparat facility and other former Soviet BW facilities are forced to convert in an environment that is radically different from Fort Detrick or other former BW facilities. Therefore, a new approach is needed that incorporates basic principles of conversion and yet takes into account the unique conditions facing Soviet facilities. The first part of this section will outline the key steps of the approach for conversion in the Former Soviet Union (FSU) which we consider appropriate in light of present conditions and past experiences. The second part will apply this approach to the Stepnogorsk case and recommend ways to increase the chances of successful conversion for this facility.

A. Appropriate Approach for Conversion of Former Soviet BW Facilities

Considering that the main challenge for former Soviet defense facilities is to perform their conversion on the economic level, it is important to provide them with the tools that will allow them to adjust to a market environment. This will include four main steps outlined below:

C Conduct a technical and financial audit of existing resources: It is important to clarify what resources are available for conversion and what is the financial situation of these facilities before conversion starts. A technical and financial audit of these facilities will help attain that goal. In terms of a technical audit, this will involve a detailed inventory of the strains, equipment, buildings, and other infrastructure on site. It will be important to determine the composition of the employees still working at the facility, from senior scientists, junior scientists, engineers, technicians, administrative workers, and other support personnel. For the scientific staff, it will be important to specify their age and prior work experience (i.e., expertise, work with particular equipment and materials). This information will identify which employees will be able to convert to new activities and which employees will need to be fired or supported through various incentives, such as early retirement. In addition, since Soviet facilities were dual use, it will be important to determine what civilian activities were formerly conducted and what activities are currently underway. All of this information will help determine what capabilities are present on-site, how these pose proliferation risks, and what skills and resources could be used to create commercial activities and products.

Secondly, it will be important to conduct a financial audit of the facility. This will involve studying the present and past financial situation of the facility to see how it has evolved over time. This will consist of examining the current budget, including the share of state funding, outside assistance, and debts. Other important questions will include: What are the energy requirements of the facility? Does the facility still support social infrastructure? Is the facility part of a larger consortium? Also, it will be necessary to determine the current partners or clients of the facility. How were these business relationships formed? What is the financial situation of these clients and how do they pay for their services (i.e., cash, barter, or surrogate money)? Additional questions should target the influence of the local economic environment: How important is the facility in the local economy? How does the facility contribute to tax payments and local employment (directly and indirectly) in the region?

C Identify potential products and activities: From the technical portion of the audit, it will be possible to determine what the facility could do with its available resources and then generate a list of possible products and activities. In terms of products, either high tech or low tech products can be considered. Both types of products have benefits and drawbacks. High tech products are favorable if they can gain a competitive edge and fill a niche. Such products typically give a high unit price, but foreign competition can be stiff. In contrast, low tech products have a lower starting/production cost and a lower unit price. But, if the product is geared towards mass consumption, then this can offset the lower unit price. Also, the low tech product might be adapted or expanded to target a wider range of clients, which can increase the overall profit. For example, this could include production of enzymes for the food, chemical, and textile industries.

Other potential activities could involve renting space or conducting consulting work. For example, some facilities could work to attract new businesses to their facility in order to utilize unused building space. This approach could be designed to create business incubators around former BW institutes, stimulating local or regional biotech development and innovation. In addition, facilities could pursue consulting work for profitable sectors of the economy. For example, former BW facilities could conduct environmental analysis and monitor infectious diseases around national/regional oil and gas extraction sites or previously contaminated sites.

C Conduct feasibility studies: Once potential products and activities are identified then the facility should conduct an in-depth study of these prospects. This study should identify: Who are the potential clients and are they solvent? Where are they located? Could they be interested in the product or service? What incentives or policies could be used by the government to motivate the customer? What are the potential obstacles (i.e., economic, political, technical) to the project? Those products or activities that would be the least costly to implement and generate profits in the short term could be prioritized over longer term projects. On the other hand, if one product or activity looks particularly promising, then the facility could concentrate its resources on that project.

C Conduct market research: Once background feasibility studies have been done, then the facility should conduct market research on a specific product or activity. This will identify what resources (i.e., buildings, equipment, personnel) could be used and what others could be eliminated. Detailed market research could also identify the potential market (local, national, regional), and a likely partner. This will help the facility concentrate its resources on a potentially profitable activity. Once market research is finished, then the product could be field tested to gauge producer/consumer interest. Alternatively, for consultancy work, a small field study could be carried out to obtain results that can be used to show prospective clients. Information campaigns could also be launched to inform the client or customers about the product or the importance of the work. In addition, once potential products or activities are identified, then the facility could start building a base of support for these projects, to include local and national officials. In particular, government support could be very useful in establishing favorable policies for these conversion efforts (i.e., providing subsidies, tax benefits, new regulations for certain industries).

At first glance, the approach described above looks like a technology-push approach, and we may ask how different it is from the one already implemented unsuccessfully by defense directors. In the absence of a proper market environment in the Former Soviet Union, it is extremely difficult to apply a strict market-pull approach. Further, in contrast to the approach usually implemented by defense directors, the one proposed here has two advantages: (1) it is based on a clear inventory of the resources available for conversion, (2) it is supported by an analysis of the existing or potential demand. With these concepts in mind, let us see how we can apply these principles to conversion at Stepnogorsk.

B. Appropriate Approach for Conversion at Stepnogorsk Facilities

1. Technical and Financial Audit

The present study provides a brief inventory of the resources available at Stepnogorsk and some figures regarding the financial status of the facility. However, a proper audit should provide a clarification on the composition of personnel, their age, expertise, and prior work. A full inventory of the equipment still available with a description of its condition is also needed. Financial information should clarify the budget of the NCB and of its members, as well as the level of their debts and a list of their creditors. It should also provide a breakdown of the salaries, the cost of utilities and other information mentioned in the paragraphs above.

2. Potential Products and Activities

Preliminary research has shown that the pharmaceutical and food/agricultural industries are two sectors with long-term potential in Kazakhstan. The fact that the NCB has chosen to produce products for these two sectors of the economy is encouraging. For instance, the enzyme starter developed by the IPB has high market potential. Since fermented dairy products are a staple of the Kazakh diet, the use of this starter in making better tasting fermented dairy products such as yogurt and kefir could have wide consumer appeal. In addition, selling the starter to local dairy producers would have low upfront costs.

In general, due to the shortage of funds at Stepnogorsk, projects based on research should be preferred over large-scale production. Production requires significant start-up costs while the returns may show only in the longer term. Further, production requires the supply of raw materials and other products, which would need to be transported to Stepnogorsk. In addition to the cost of transportation, the bad condition of local roads would hinder a regular supply flow and would make the distribution of finished products more difficult. On the other hand, research activities do not require as much start-up funds. The facility can also use the small-scale production equipment to conduct pilot production and test its products.

Aspect-pharm staff bottling "Ovsa," a medicinal oat-based tonic useful in treating anemia, insomnia, influenza, and physical and mental exhaustion. The tonic is sold in local Stepnogorsk pharmacies.

3. Feasibility Study

Today Kazakhstan produces only 5 percent of its domestic drugs consumption, and the agricultural sector is one of the main fields of activity in Kazakhstan.[169] However, these two sectors are in a bad financial state. Hospitals and other medical organizations, as well as farmers, or food-processing enterprises do not have the means to order and buy products from biotech facilities.[170] In this context, there is a dire need for a state policy supporting these sectors by offering

[169] European Observatory on Health Care Systems, *Health Care Systems in Transition: Kazakhstan* (Copenhagen: European Observatory on Health Care Systems, 1999), p. 47.

[170] In 1997, only 10 percent of the State Health budget was devoted to pharmaceutical expenditures. Patients must purchase their own drugs, including patients admitted to hospitals, even though the official Kazakh government policy requires drugs to be supplied by the hospital. See European Observatory on Health Care Systems, *Health Care Systems*, p. 48.

fiscal incentives (such as tax exemptions) to encourage cooperation with former Soviet biotech facilities.

To increase the chances of commercial success of the starter developed at the IPB, the Ministry of Agriculture or Health could subsidize the production costs of the IPB starter and, at the same time, impose taxes on other starters that are currently being used by the dairy producers. The other productions started by the IPB, would also benefit from a properly conducted feasibility study, in order to help the institute concentrate its resources on a range of product with market potential.

4. What Role Can Foreign Assistance Play in Conversion?

There is also a dire need for international assistance to help the facility conduct a proper market research and feasibility study. The NCB will require some assistance to conduct an appropriate market research, identify a limited number of activities with market potential, and link with solvent customers. It is essential that NCB employees receive training in order to understand the basic principles of the market. This type of education can easily be provided by international assistance. For example, the European Union commonly finances this type of assistance in Russia and other FSU countries.[171] Assistance can also be provided to help the NCB to conduct market research and identify the products that it can provide using its available resources. In addition, the NCB will need a regular flow of information regarding the target market. This also can be done with the support of international assistance. For instance, a marketing department could be set up at the NCB, employing people with training in marketing and the required equipment to conduct their work (i.e., computers, internet, access to information).

In the case of the enzyme starter developed by the NCB, foreign assistance could train a small group of people from the IPB and designate a consultant to guide them while conducting the feasibility study of manufacturing the starter, and help them identify several local dairy producers in the region that are solvent. Assistance would also be required for the follow-on market

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[171] Some of these programs are financed through European Union programs dealing with countries of the former Soviet Union such as: (1) TACIS, which provides grant-financed technical assistance, (2) PHARE, which provides financing for institution building, technical assistance, and investment support, and (3) the European Bank of Reconstruction and Development (EBRD), which provides financing for banks, industries, and businesses. See: http://europa.eu.int/comm/external_relations/ceeca/tacis/index.htm; http://www.ebrd.com/about/index.htm; http://europa.eu.int/comm/enlargement/pas/phare.

research, exploring the interest of both local and national dairy producers, as well as some producers in countries consuming the same type of dairy products, like Russia, other New Independent States, Mongolia or China. Foreign assistance could also help the IPB field test its starter in one local dairy producer to gauge producer and customer interest in the product.

Guidance from a consultant could also be helpful to explore the possibility of expanding the now limited market for the production of the small company Aspect-pharm.[172] This enterprise now implements IPP projects for the IPB, and in the future, other cooperative projects could go through Aspect-pharm. A proper business training of its personnel would help build a bridge between nonproliferation projects and commercialization for the local market, thus increasing the long-term effects of nonproliferation programs.

Foreign assistance could also be used to encourage the Kazakh government to develop and implement policies regarding promising sectors for conversion of its BW facilities. This assistance can take the form of studies detailing the status of these sectors today and projecting their development potential for the next decade or so. Assistance can also be provided to simplify and rationalize the certification process of domestic drugs.[173] State and foreign assistance can be used to help design policies to encourage sectors of the economy that are already solvent, such as the oil industry, to cooperate with former defense enterprises. For instance, the Environmental Monitoring Laboratory could do environmental research around oil deposit sites to evaluate their contamination level. One Almaty-based nuclear facility already does this type of work quite successfully.[174]

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[172] This small company was created to avoid government restrictions and decrease administrative hurdles involved in cooperation with foreign partners. Interview of Vladimir Bugreev, by Sonia Ben Ouagrham, Stepnogorsk, Kazakhstan, April 2000.

[173] Certification of drugs produced by local producers is also a major issue that needs to be addressed. Certification of new drugs in Kazakhstan is currently so expensive that the cost of new locally-produced drugs would exceed the price of foreign drugs already on the market. Furthermore, many foreign drugs are imported illegally. In 1992, the Cabinet of Ministers decided to create a State pharmaceutical company called "Kazpharmbioprom," in order to increase the production of drugs in Kazakhstan. This state company was to be composed of state and private enterprises of the pharmaceutical sector. Little is known about the status of this project. Similarly, in 1999, a program to support the agricultural sector was being designed by the government. Here again little information is available on the status of this program. The frequent turnover within government administrations and frequent policy changes are probably the main reasons why these programs have not been implemented yet. "O bednoi zolushke po imeni pharmatsia," (A poor Cinderella called Pharmaceutical Industry) *Kazakhskaia Pravda*, 16 September 1992, p. 4.

[174] For instance, the Institute of Nuclear Physics (INP) of Almaty conducts environmental research around oil deposits located on a former nuclear test site in the north west of Kazakhstan for a consortium of foreign oil companies. This contract provides the INP with $2 million per year over 20 years.

A distinguishing characteristic of Kazakhstan is the concentration of governmental power on priorities defined by President Nazerbaev. If conversion were to become a presidential priority, more particularly through the development of the agricultural and pharmaceutical industries, the chances would be much greater that national programs would be more consistently developed and implemented. However, even if the required policies are implemented by the state and international assistance, these programs will need time to bear fruit. Therefore, it is essential that short-term programs be continued or new ones started in order to ensure the "survival" of the facility. However they need to be structured in such a way that the projects started today will be integrated into a long term strategy. Nonproliferation programs for instance can help support the facility in the short-term, but to be efficient these projects should be designed and structured in the context of a longer term conversion plan. Otherwise, these programs will only serve as a band-aid to the underlying economic difficulties, without contributing to sustainable economic development, thereby maintaining the long-term brain drain proliferation threat.

5. Role of U.S. and International Assistance in Promoting Nonproliferation at Stepnogorsk

In terms of nonproliferation, reliable assessment of whether complete demilitarization has occurred at a former BW production facility is difficult. At the core, this involves analyzing the following: (1) assessing the establishment of a national policy outlawing offensive BW work, adherence to the BTWC, and upholding the norm of BW disarmament and nonproliferation; (2) credible documentation of prior and present work at the facility and a reasonable means to check this; (3) verifiable destruction of specialized equipment and infrastructure used for prior on-site weaponization activities; and (4) an end to secrecy, with open access to the facility and personnel by the international community.[175] These principles have been used in the development of domestic and international BW verification methods, as well as in U.N. inspection activities in Iraq. Continual evaluation of these characteristics can also track whether future reversion is possible. In light of these criteria, how well do the Stepnogorsk facilities measure up to these standards? What role has U.S. assistance played in promoting nonproliferation in Kazakhstan?

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[175] Secrecy is defined here as classified information related to national security, not secrecy involved with protecting of proprietary information. Two publications have outlined in greater detail some specifics of this: Leitenberg, "The Conversion of Biological Warfare Research and Development Facilities to Peaceful Uses," in *Control of Dual-Threat Agents*, pp. 103-05; and Ernst Buder and Erhard Geissler, "Conversion of Former BTW Facilities—Questions and Problems," in *Conversion of Former BTW Facilities*, p. 5.

- <u>The establishment of a national policy outlawing offensive BW work, adherence to the BTWC, and upholding the norm of BW disarmament and nonproliferation:</u> Kazakhstan holds a mixed picture on this point. Kazakhstan has not declared an official policy against biological weapons, is not a state party to the BTWC, nor a member of the Australia Group. President Nazerbaev, however, has declared Kazakhstan's commitment to the nonproliferation of BW and their technologies. Kazakhstan has also been an active partner in the dismantlement of Kazakhstan's largest BW facility under the CTR program.

  Kazakhstan may be waiting to act on the BTWC until it receives some indication of international assistance for conversion of its former BW facilities. Although Kazakhstan signed the Chemical Weapons Convention in 1993, it only ratified the treaty in March 2000. Part of the delay has been attributed to the lack of funding for conversion or dismantlement of its chemical weapons and CW production facilities. A similar reason may hold for Kazakhstan's participation to the BTWC. International assistance for conversion could be a positive influence in helping Kazakhstan become a full member of the Chemical and Biological Weapons Conventions.

  On a related note, the Biomedpreparat facility has been under the control of purely civilian ministries since the beginning of the new Kazakh government. In fact, the National Center for Biotechnology was established to create a civilian administrative body to have jurisdiction over most of the former BW facilities in Kazakhstan. Furthermore, as of April 2001, the directorship of the NCB transferred from Lepyoshkin (former bioweaponeer and colonel in the Soviet army) to a purely civilian scientist. With this reorganization, the directors of the IPB and Environmental Monitoring Laboratory (former bioweaponeers) also have been replaced by civilian scientists who were never involved in weapons activities.
- <u>Credible documentation of prior and present work at the facility and a reasonable means to check this:</u> Since 1997, CTR's dismantlement effort has documented all prior offensive BW equipment on-site. As of September 2000, U.S. Department of Defense officials had documented that there is no remaining equipment or infrastructure at Biomedpreparat that remains as an offensive BW threat. Continuous U.S. oversight (via visits and scientific exchanges) since the start of dismantlement offers definitive proof that offensive work at Biomedpreparat has ended. All of the scientific research work that has been sponsored by U.S. or ISTC assistance does not involve dual-threat agents or defensive BW projects. Due to the dismantlement of the facility, all research is conducted off-site of the former BW complex.[176] To date, this is the first time that the offensive threat has been eliminated from a former Soviet BW facility.
- <u>Verifiable destruction of specialized equipment and infrastructure used for prior on-site weaponization activities:</u> As of September 2000, Biomedpreparat (working with CTR) had destroyed all former equipment that was deemed critical to BW production. This included fermentors, centrifugal separators, air handling systems, weapons filling equipment, drying and milling equipment, and others. Also, the CTR program is still negotiating a contract to completely eliminate remaining buildings associated with former

[176] Dual threat agents are defined here as bacteria, viruses, fungi, and toxins that cause disease in humans, animals, and plants, and are also putative BW agents.

BW production activities. Once this is accomplished, the threat of reversion at Biomedpreparat will be eliminated.

- An end to secrecy, with open access to the facility and personnel by the international community: Since the dismantlement project started in 1998, U.S. government officials have had complete and continued access to the entire complex. In addition, international journalists, scientists, educators, and businesspeople have been able to visit Biomedpreparat. For example, in July 2000, an international conference, sponsored by the ISTC, was held in Stepnogorsk. This conference included a half-day visit to the site of the former BW production facility. As this study shows, the Biomedpreparat management and scientists are open to discussing current program activities, funding, and personnel. In addition to granting press and academic interviews, Lepyoshkin and his managers discussed current activities at Biomedpreparat, IPB, and the Monitoring Laboratory at a 1999 conference in California, and a May 2001 conference in Almaty.[177]

  Through a variety of U.S. and international assistance programs (i.e., ISTC, IPP, and other travel grant programs), Stepnogorsk scientists have been able to attend biotechnology conferences and meet with foreign collaborators. Biomedpreparat, IPB, and the Environmental Monitoring Laboratory all conduct open, civilian activities. There are no restrictions imposed by the Kazakh government for Stepnogorsk scientists to present their research findings.

Three out of the four characteristics listed above would not have been met without U.S. and international assistance. Such assistance has been crucial in meeting demilitarization requirements that serve as prerequisites to conversion, and to the nonproliferation of sensitive BW technologies, equipment, and materials at Stepnogorsk. Despite conflicts in the AAI project, subsequent relationships between U.S. government officials and Stepnogorsk bioweaponeers have been more positive. For example, U.S. Department of Defense officials developed close, personal relationships with Dr. Lepyoshkin and other managers which have increased dialogue and resolution of conflicts regarding dismantlement contracts and implementation of ISTC/IPP projects. These relationships have increased transparency into these facilities and their on-going activities. It is important that the U.S. government continues to work on these relationships. Positive working relationships with Stepnogorsk bioweaponeers will help building a good reputation for U.S. assistance in the region, which can then facilitate additional dismantlement and redirection projects at other former Soviet BW facilities.

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[177] Michael Dobbs, "Soviet Era Work on Bioweapons Still Worrisome," p. A1; For a description of conference activities see the following internet links: http://cns.miis.edu/cns/projects/nisnp/research/ctrconf/index.htm; http://cns.miis.edu/cns/projects/nisnp/research/bioweap/step.htm; http://cns.miis.edu/cns/projects/nisnp/research/bioweap/01agend.htm.

Since the dismantlement of the facility was completed in 2000, there is no longer a proliferation or offensive military threat from the former equipment or infrastructure at this facility. Yet, as mentioned above, proliferation concerns still remain regarding existing personnel. In contrast to nuclear weapons technology, materials and equipment used to develop biological weapons are inherently dual-use. Therefore, the ability to develop potent biological weapons is primarily dependent on expertise. This makes bioweapons-related knowledge particularly sensitive. As mentioned previously, there are approximately 40 former bioweaponeers in Stepnogorsk, some of whom have extensive knowledge of the complete stages of BW development, production and weaponization.

Since Spring 2001 several former bioweaponeers in Stepnogorsk have been fired and remain unemployed. For instance, in Spring 2002, Dr. Lepyoshkin was reported to have plans to move to Kirov, Russia to work with the Volga-Vyatsky Center for Applied Biotechnology. At the Center, Lepyoshkin planned to establish a research program devoted to developing technologies for the destruction of chemical weapons.[178] In spite of Lepyoshkin's plans, he was still in Kazakhstan as of July 2002. It is unclear what problems are preventing his move to Russia. Similarly, as of April 2002, Bugreev and some of his co-workers in the IPB (former bioweaponeers) have moved to the Novosibirsk region of Russia, reportedly looking for work at the Berdsk biochemical plant. From discussions with U.S. government officials, it is unclear whether long-term job opportunities exist at these Russian institutes for these scientists. According to U.S. government officials, there are no current plans to support either Lepyoshkin or Bugreev with CTR funding in their new work plans.[179]

In light of these actions, concerns have been raised about the potential "brain drain" of these bioweaponeers. Since 1997, these former bioweaponeers have not actively worked with biological agents in offensive or defensive work. Therefore, how much of a proliferation threat do these scientists pose? Over time, does this weapons knowledge erode from a lack of use? Perhaps.

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[178] As a side note, the director and several employees of the Volga-Vyatsky Center were former employees of the Ministry of Defense BW facility, the Scientific Research Institute of Microbiology, located in Kirov.

[179] U.S. government official, personal communication to authors, 23 April 2002 and 22 May 2002.

Sociological studies have shown that various scientific and technological developments, from the building of lasers to the creation of new biological procedures, contain important elements of tacit knowledge.[180] Tacit knowledge is knowledge that has not been formulated explicitly (i.e., as recipes, diagrams, computer files, or protocols), but is acquired and retained by direct laboratory experience, interaction with other scientists, and other personal or social means. Because it is person specific and local, tacit knowledge can be difficult to transfer effectively and can be lost through lack of use. Once lost, the reacquisition of tacit knowledge is not necessarily easy and may involve a relearning and development process similar to the original effort.

In the field of arms control and nonproliferation, Donald MacKenzie and Graham Spinardi have applied these sociological theories regarding tacit knowledge to successful nuclear weapons design and production.[181] Through extensive interviews with former weapons designers and examination of the historical record on global nuclear weapons development and proliferation, MacKenzie and Spinardi find unique and important aspects of tacit knowledge. In the context of a global nuclear test ban, MacKenzie and Spinardi argue that if nuclear weapons design and testing cease and critical tacit knowledge is not transferred to a new generation of designers, then eventually the technology involved in nuclear weapon development will be lost. MacKenzie and Spinardi contend that, "after a sufficiently long hiatus, we would expect the effort needed to re-create nuclear arsenals to become quite considerable, even for those who possessed detailed documentary records from their original development."[182] In essence, nuclear weapons will have to be reinvented virtually from scratch.

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[180] See H.M. Collins, "Tacit Knowledge, Trust, and the Q of Sapphire," *Social Studies of Science* 31, no. 1 (2001): 71-85; H.M. Collins, "The TEA Set: Tacit Knowledge and Scientific Networks," *Science Studies* 4 (1974): 165-86; T. Pinch, H.M. Collins, and Larry Carbone, "Inside Knowledge: Second Order Measures of Skill," *Sociological Review* 44, no. 2 (1996): 163-86; Kathleen Jordan and Michael Lynch, "The Sociology of a Genetic Engineering Technique: Ritual and Rationality in the Performance of the Plasmid Prep," *The Right Tools for the Job: At Work in 20th Century Life Sciences*, ed. Adele E. Clark and Joan H. Fujimura (Princeton: Princeton University Press, 1992), pp. 77-114; Alberto Cambrosio and Peter Keating, "Going Monoclonal: Art, Science, and Magic in the Day-to-Day Use of Hybridoma Technology," *Social Problems* 35, no. 3 (1988): 244-60.

[181] Donald MacKenzie and Graham Spinardi, "Tacit Knowledge, Weapons Design, and the Uninvention of Nuclear Weapons," *American Journal of Sociology* 101 (July 1995): 44-99; Also see Donald MacKenzie, "Moving Toward Disinvention," *Bulletin of the Atomic Scientists* 52, no. 5 (September/October 1996); Judith Reppy, "Dual-Use Technology: Back to the Future," in *Arming the Future: A Defense Industry for the 21st Century*, ed. Ann R. Markusen and Sean S. Costigan (New York: Council on Foreign Relations, 1999), 269-84.

[182] MacKenzie and Spinardi, "Tacit Knowledge," p. 88.

The arguments that Mackenzie and Spinardi put forward are controversial, yet intriguing. The salience of these arguments to the development of other weapons of mass destruction is unknown. To date, there have been no studies that have examined what tacit components exist in biological weapons technology and development, and how this type of knowledge erodes over time. Therefore, it is difficult to conclude whether the bioweaponeers remaining at Stepnogorsk have lost some important tacit aspects of their BW knowledge. Arguably, ten years have passed, no work with dual-threat agents has continued, and no new generation of bioweaponeers has been trained in weapons work during that time in Stepnogorsk. Yet, it is important to note that a small number of these Stepnogorsk scientists possess twenty or more years of experience working with anthrax and other biological weapons agents. A few, like Dr. Lepyoshkin, have knowledge of the entire weaponization process. It is likely that such breadth and range of knowledge regarding bioweapons development has persisted and will continue to pose some proliferation risks. The future risk of this knowledge is unknown. Detailed studies are needed to understand the tacit components involved in the development of bioweapons knowledge and the ability of this knowledge to erode over time.

6. The Relationship Between Nonproliferation And Conversion

In many cases, there appears to be a close relationship between nonproliferation and conversion. For example, long term economic sustainability for these facilities and their personnel can decrease incentives to engage in illicit activities. Therefore, successful conversion can play an important role in decreasing proliferation threats. At the same time, some nonproliferation policies can assist in conversion. CTR destruction of weapons equipment and infrastructure has eliminated excess resources and expenses that would have otherwise hampered conversion efforts. Yet, it is important to realize that sometimes nonproliferation and conversion can come into conflict with one another. Although these conflicts are not irreconcilable, they are worth identifying and analyzing. We have identified three instances at Stepnogorsk where there is a contradiction between nonproliferation and conversion.

First, recent Kazakh government administrative changes have brought a new civilian director to the NCB and have placed the former weapons facilities under a new Ministry. From a pure nonproliferation perspective, these are positive developments since the new authorities have never been associated with prior biological weapons activities and will likely continue to support redirection of these facilities to civilian and commercial activities. However, the new director of the NCB has developed his own agenda, which has involved restructuring of the activities of the NCB, IPB, and Environmental Monitoring Laboratory. This restructuring has resulted in the firing of some critical bioweaponeers, such as Dr. Lepyoshkin and Dr. Bugreev. Although these scientists are still involved in some U.S. government research projects, their future is now uncertain in Kazakhstan. It appears that the new director sees these former managers as threats to his agenda. Further, the new director has expressed his desire to move the Monitoring Laboratory from Stepnogorsk to his home city of Karaganda, potentially leaving the Stepnogorsk bioweaponeers behind. The departure of Lepyoshkin and Bugreev, as well as the uncertain future of other bioweaponeers, may open new "brain drain" proliferation threats. In addition, the removal of the Monitoring Laboratory and other biotech equipment would greatly impede future efforts at conversion in Stepnogorsk.

Second, prior to 2001, Biomedpreparat and the IPB enjoyed consistent support from Minister Shkolnik. The shuffling of Biomedpreparat and the IPB to a new Ministry has destroyed important government support that could have been used to prioritize and implement conversion projects. Biomedpreparat and the IPB have lost their influence in the government and will now have to justify their existence to the new Ministry. It will take time and significant effort to develop relationships between the Stepnogorsk facilities and the new Minister. U.S. government officials are currently evaluating ways to constructively deal with these restructuring activities and encourage the new NCB director and Minister to consider the proliferation implications of future reorganization decisions.

Another contradiction between nonproliferation and conversion involves the formation of small businesses, such as Aspect pharm, under the IPB and other state owned facilities. Eighty percent of the shares of Aspect-pharm are privately held; 20 percent are state owned. The establishment of businesses like Aspect-pharm creates more favorable avenues for joint ventures with foreign companies and provides mechanisms to circumvent the obstacles posed by continual government reshuffling. However, these businesses can also introduce some proliferation risks. Although they employ former weapons personnel, these businesses are not controlled or regulated like the state-owned facilities. Even if the enterprise and the shareholders are registered, it is possible that these shares can change hands with no documentation. In theory this is illegal, but in practice it occurs frequently. Therefore, unknown foreign entities could buy shares within these businesses. This may open a conduit for technology transfer of bioweapons knowledge.

This nonproliferation problem encountered with Aspect-pharm points to a need to make state-owned facilities, such as Biomedpreparat and the IPB, more flexible in conducting their conversion activities. For example, instead of submitting every proposed project and joint venture to the government, the facilities could develop the contracts independently. Then, once the contract is ready, the government could step in to evaluate the proposed work and decide whether to approve the contract. This approach would provide for oversight of activities that the facility is undertaking, but would give the facility greater flexibility and independence in pursuing commercial activities. Such approaches have been used successfully in Russian defense facilities to reconcile conflicts between nonproliferation and conversion.

V. CONCLUSION

The road to conversion has been rocky for Biomedpreparat and its sister facilities. To date, there has been no successful conversion project at the facility. Several extenuating circumstances, such as a difficult political and economic situation and flawed U.S. government assistance, can explain this outcome. Yet, we have determined that conversion is not doomed at Stepnogorsk if an appropriate long-term strategy for economic development can be crafted and implemented. This will not be easy and will likely take years to bear fruit. But, with Kazakh government and international assistance, there are possibilities. Important nonproliferation objectives have been reached—more remain. The continued proliferation of BW sensitive technology to countries hostile to the United States, makes Nunn-Lugar assistance programs at Stepnogorsk and other former Soviet BW facilities a national security priority. Given the lessons learned at Stepnogorsk, what broader issues affect conversion prospects at other former Soviet BW facilities?

Most former Soviet BW facilities remain shrouded in a veil of secrecy and mystery. Even ten years after Yeltsin's decree abolishing offensive BW work and Ken Alibek's revelations, there is still much that is unknown about the history of these facilities, their former activities, as well as the number and expertise of their former bioweaponeers. Such information is important to ensure the cessation of offensive activities and to design appropriate conversion and nonproliferation projects.[183] In May 2001, a new Russian scientific council was created to serve in an advisory capacity to the Russian government on matters regarding chemical and biological weapons issues and facilities. This council is composed of several directors from the former chemical and biological weapons establishments and well-known "hawks." Although the status and influence of this committee are unknown, this development reinforces concerns about Russia's future plans for its former BW facilities. Without full transparency, a measure of stigma is likely to remain at these facilities that can dissuade foreign investors from pursuing joint commercial ventures.

Furthermore, in many cases, the administrative control of former Soviet BW facilities is ambiguous. In Kazakhstan, the Stepnogorsk facilities have been continually shifted to the control of different government ministries, with constant reshuffling of government personnel. In Russia, the enigmatic Biopreparat administration still exerts its control over several former BW institutes—although to what extent remains unknown. At the same time, some former BW institutes in Russia are under the control of more than one ministry. For most collaborative research projects, such as the ISTC programs, projects can be designed and implemented without receiving approvals of specific government ministries. For dismantlement or conversion projects, however, the United States must negotiate an implementing agreement with the government agencies that own and control the facilities. In Russia, mixed jurisdiction involving former BW facilities can complicate and delay agreements for dismantlement or conversion projects.[184] In addition to the difficulties experienced in Kazakhstan and Russia, other administrative problems may exist within other former Soviet republics. Such uncertainties can make foreign investors wary of former Soviet BW facilities.

Although a complete understanding of the former Soviet BW complex remains elusive, U.S. and international assistance has greatly increased access and transparency into many facilities. Since 1995, more than 40 former Soviet BW facilities have been involved in cooperative

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183 The Russian government has not yet disclosed a complete history and accounting of the Soviet biological weapons program. As a result, in April 2002 the U.S. government informed Moscow that it would not fund new disarmament projects under the Nunn-Lugar program, more particularly the Cooperative Threat Reduction program. Although this restriction was lifted in August 2002 by President Bush, outstanding issues remain regarding the Russian BW establishment. See Judith Miller, "U.S. Warns Russia of Need to Verify Treaty Compliance," *New York Times*, 8 April 2002; Judith Miller, "U.S. to Help Reduce Threat of Russian Arms," *New York Times*, 9 August 2002.

184 Michelle Stem Cook and Amy F. Woolf, *Preventing Proliferation of Biological Weapons: U.S. Assistance to the Former Soviet States*, CRS Report for Congress, 10 April 2002, p. 14.

projects with the United States.[185] In one particularly noteworthy development, one former BW facility under the Ministry of Defense has become a civilian entity. As of 2001, the Kirov-200 Institute of Microbiology in Strizhi, Russia, has been transferred from the jurisdiction of the Ministry of Defense to the Ministry of Education. Through informal discussions Kirov-200 officials have expressed interest in receiving U.S. nonproliferation assistance and there are on-going discussions for plans to allocate some State and DOD funding for dismantlement and redirection projects.[186] It is important to note that Kirov-200 officials made this request for assistance after hearing of the Nunn-Lugar activities at other former BW institutes, as well as through subsequent dialogues with U.S. government officials. Future U.S. government involvement at Strizhi will mark a major milestone in increasing transparency into the reticent Ministry of Defense facilities.

Nunn-Lugar assistance, however, currently lacks one important tool to assist facilities like Strizhi in redirecting to peaceful activities—Congressional support and funding for conversion. To date, most Nunn-Lugar assistance to former BW facilities involves programs that can indirectly (passively) promote conversion. These include CTR dismantlement projects and the development of research and technologies under the ISTC and IPP that have commercial applications. Yet, there is no explicit U.S. government program focused on conversion. In part, this stems from a 1996 Congressional restriction prohibiting any new CTR funds to be used for defense conversion, as well as the general aversion to appropriate U.S. taxpayer dollars to support any programs that smack of "foreign aid."

This study has shown, however, that piecemeal research and dismantlement activities, although important for short-term nonproliferation priorities, do not necessarily promote long-term economic stability to former bioweaponeers—a key factor in mitigating the long-term brain drain proliferation threat of sensitive BW expertise. Although they are aging, many bioweaponeers face twenty or more years before retirement. Without sustainable employment to support themselves and their families, they may be tempted to profit from selling their knowledge to questionable entities. Apart from the brain-drain concerns, without a well-developed plan for

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185 Ibid, p. 16.

186 U.S. government official, telephone interview by Kathleen M. Vogel, 26 March 2002.

long-term economic sustainability of these former bioweaponeers, it is difficult to construct and implement appropriate exit strategies for U.S. and international assistance.

New U.S. government assistance for conversion efforts involving former bioweaponeers and/or their institutes, along with continuing complementary nonproliferation support can start addressing these long-term issues. Five years have passed since the Biomedpreparat-AAI conversion debacle. In light of the current situation, should Congressional restrictions be reversed to authorize conversion activities under the CTR program? Can it be guaranteed that U.S. taxpayer dollars will lead to successful conversion efforts that benefit U.S. national security?

As mentioned previously, successful conversion of any defense facility, whether in western countries or the Former Soviet Union is exceedingly difficult. There is no guarantee that future U.S. assistance will lead to successful conversion. Yet for some facilities, what other alternatives exist? In the Stepnogorsk case, although dismantlement of the facility is almost complete, 40 bioweaponeers remain with an uncertain future. It is likely that in other institutes this number will be higher. Conversion plans, if designed and implemented properly, can provide some measure of hope for these scientists to become economically self-reliant. A reversal of Congressional restrictions on funding for conversion activities would play a crucial role in moving these scientists and their facilities towards the goal of self-sufficiency. In supporting conversion, there are two different strategies that can be implemented depending on the nature of the threat present at specific facilities. This threat will depend on the environment surrounding the facilities and on their needs.

The first type of conversion strategy can be qualified as a “Disarmament conversion.” The aims of this strategy will largely focus on employing former BW personnel for a few years, in order to generate a gradual loss of their weapons knowledge (i.e., tacit knowledge) and/or their gradual integration into the local economy. This type of conversion is appropriate where the local economy can offer alternative jobs to the excess personnel, or where the facilities have developed successful commercial activities. As economic development is not the prime objective of this type of conversion, piece-meal assistance programs as they are implemented today under a variety of Nunn-Lugar programs, could constitute a disarmament conversion. A crucial aspect of this strategy is to design these assistance programs in way that does not employ former BW personnel in activities that can maintain that specific BW-related knowledge (i.e., biodefense projects). Being a short termed program, with the objective of destroying a resource (knowledge) that can be of proliferation concern, this type of conversion fits the mandate of the CTR program.

The second type of conversion strategy can be qualified as "economically-sound conversion." This type of conversion aims to generate long-term sustainable development. This strategy takes into account situations where the local or regional economies cannot offer outlets to the excess weapons personnel, thus creating a probable risk of proliferation through brain drain. Stepnogorsk is a good example of this type of environment. This type of conversion will require a long-term effort and investment. However, this long-term program can be divided into several short-term stages that can be implemented by various agencies or organizations. In this context, CTR can also efficiently serve this type of conversion by designing its projects at BW facilities as first stages of longer-term development programs. This would increase the efficiency of each dollar invested in nonproliferation programs and would also allow the planning of an exit strategy from the outset. It must be kept in mind, however, that this type of strategy requires a high level of coordination among the various players providing assistance to ensure that a long-term strategy is consistently pursued. Although the Stepnogorsk Initiative provided a model for this type of U.S. interagency coordination, much more coordination and planning will be needed over a longer period of time.

As this study has illustrated, a conversion plan should consist of developing short-term projects to address immediate economic concerns, as well as programs and activities to promote long term economic development when needed. Regardless of which federal agency takes the lead, conversion must be seen as a medium to long-term policy objective, requiring committed funding over a period of time. Also, conversion programs need to be designed in ways to insulate them from the pressures of showing quick results—something that plagued the Stepnogorsk and other defense conversion projects.[187] Conversion plans also need to be site-specific, and take into account the technical, political social, and other characteristics comprising the environment, this information should guide the level of U.S. investment and effort required. In some cases, conver-

[187] Projects under the Nuclear Cities Initiative have also suffered from a lack of a comprehensive review to screen for commercial potential. DOE officials state they were under pressure to quickly implement projects and engage Russians. A GAO report concludes that the success of NCI projects has been limited by the program's failure to rigorously screen projects before approving them. See U.S. General Accounting Office, *Nuclear Nonproliferation: Concerns with DOE's Efforts to Reduce the Risks Posed by Russia's Unemployed Weapons Scientists*, GAO/RCED-99-54, (Washington, DC: U.S. General Accounting Office, February 1999), p. 24.

sion may only involve the former bioweaponeers and be small in scale; in other cases conversion may involve the entire facility. There can be no "cookie cutter" approach to conversion—each site must be evaluated individually to assess its strengths and weaknesses. Such a site-specific approach to conversion can direct U.S. government funding where it is needed most and minimize waste of resources.

Dismantlement needs to be a key component of a long-term conversion strategy at former BW facilities. Both research and production facilities will have excess laboratory and building structures that will need to be eliminated. Such dismantlement will reduce offensive concerns, mitigate proliferation of sensitive equipment, and decrease the financial cost of maintaining such structures. From the outset, a dismantlement contract needs to be negotiated as part and parcel of any conversion assistance. Unfortunately, in the Stepnogorsk case, this requirement was not articulated from the beginning of U.S. involvement and led to serious misunderstandings and resentments between the parties. As of 2001, the new Bush Administration has started adopting a policy of requiring dismantlement activities for new Nunn-Lugar assistance in its public discussions with former Soviet BW officials.[188]

A call for reinstatement of Congressional support for conversion begs the question, "Which U.S. federal agency is best qualified to receive funding and implement the conversion plans at these facilities?" Is the DOD's CTR program the best mechanism for implementing conversion projects? Arguably, many federal agencies, such as the Department of Defense and Department of Energy, possess notoriously bad track records in converting defense facilities.[189] Moreover, the DOE's Nuclear Cities Initiative (NCI), which provides conversion assistance for Russia's closed nuclear cities, has repeatedly suffered from Congressional attacks.[190] Frequently, these agencies lack the in-house expertise to lead conversion efforts, particularly in the context

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[188] Remarks made by U.S. Department of Defense official, "Cooperative Threat Reduction, Biological Weapons Proliferation Prevention Program In-Process Projects Review Meeting," McLean, VA, 25-29 October 2001.

[189] U.S. General Accounting Office, *Nuclear Nonproliferation: Concerns with DOE's Efforts to Reduce the Risks Posed by Russia's Unemployed Weapons Scientists*; and U.S. General Accounting Office, *Nuclear Nonproliferation: DOE's Efforts to Assist Weapons Scientists in Russia's Nuclear Cities Face Challenges*, GAO-01-429 (Washington, DC: U.S. General Accounting Office, May 2001).

[190] A July 1999 House Appropriations Committee report raised concerns about DOE's competence in implementing the NCI program, particularly in relation to providing marketing and business expertise. The report recommended that DOE work with other Federal agencies to deal with this deficiency. Committee Report-House Report 106-253-Energy and Water Development Appropriations Bill, 2000, "Arms Control and Nonproliferation.

of the former Soviet Union. Obviously, the early CTR conversion efforts failed at Stepnogorsk. Nevertheless, CTR is probably the most qualified to lead new conversion activities, in partnership with other relevant U.S. government agencies, for various reasons:

- DOD has developed extensive contacts in the BW sector in the FSU. This has generated a context of greater transparency and trust within these facilities. It should not be underestimated the cultural importance of developing and cultivating good working relationships in the context of the Former Soviet Union.CTR could build on these existing relationships to develop adequate conversion programs and implement them quickly;
- The "Stepnogorsk Initiative" launched the start of a successful interagency team working on BW nonproliferation issues, bringing multiple U.S. government resources to bear on a particular facility. This initiative led to more constructive working relationships with former Stepnogorsk bioweaponeers and their management, highlighting the importance of pervasive, hands-on U.S. government involvement in Nunn-Lugar activities at former BW facilities. This successful interagency collaborative spirit has been replicated in subsequent work with other former BW facilities. In addition, this well planned collaborative effort forced a variety of U.S. government agencies to learn how to work together, and learn from their collective experiences (good and bad).
- The Department of Defense's CTR program can design dismantlement programs consistent with conversion. In contrast to State Department nonproliferation programs (which can be attacked as foreign aid), the CTR program has consistently garnered bipartisan support in Congress. If seen as part of an integrated CTR program, conversion activities may be able to receive new and sustainable Congressional support.

Finally, there is a need for greater international participation in nonproliferation and conversion efforts at former Soviet BW facilities. To date, the bulk of international contributions have involved ISTC projects—projects that have not involved significant monetary investment. Yet the prevention of brain drain and proliferation of BW technologies is an international problem. Given U.S. hesitation on providing funds for conversion projects, perhaps this is one area for complementary international involvement. As an example, the Landau Network-Centro Volta and the Italian government have recently proposed a European Nuclear Cities Initiative (ENCI).[191] This program is designed to be smaller than DOE's NCI program but would complement and support U.S. assistance. The ENCI program is proposed to start in two closed cities and will target senior nuclear weapons scientists. The initial projects will involve the development of energy efficient and environmental remediation technologies that can be used by European companies.

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[191] EU Workshop on "II International Working Group for European Nuclear Cities Initiatives," Brussels, Belgium, 25-26 February 2002, at http://lxmi.mi.infn.it/~landnet/ENCI_BRUX/.

U.S., Kazakh, and Russian participants at "Biotechnological Development in Kazakhstan: Nonproliferation, Conversion, and Investment," conference held July 24-26, 2000, in Stepnogorsk, Kazakhstan. During the conference several complaints were raised by former Soviet bioweaponeers on the nature of U.S. assistance. The conference, however, did provide an opportunity to openly discuss differences on this issue between U.S. and Kazakh officials. In addition, the conference was able to showcase existing research accomplishments by former Soviet bioweaponeers to several international participants.

A similar effort could be developed to target former Soviet BW scientists and facilities. For instance, former Soviet BW facilities have extensive experience in the monitoring of dangerous human, animal, and plant diseases. These facilities could be engaged in an international effort to create a global disease monitoring network, a good alternative to continuing biodefense work. This would allow them to apply their knowledge for the good of humanity, and would give them a sense of belonging to an international scientific community. This sense of community could eventually lift the remaining resistance to greater transparency into these facilities.

In sum, this study has shown that former Soviet BW facilities possess a unique combination of resources, characteristics, and environment that pose challenges to proliferation and long-term economic sustainability. The key proliferation threats at these facilities involve dangerous pathogen collections, dual-use equipment, and expertise on using these resources towards offensive ends. Export controls and increased security measures can mitigate the threat of illicit diversion involving material resources, but there are few existing tools that can deal with the brain drain proliferation threat. This threat remains poorly understood. More research is needed on the mechanisms of acquisition and destruction of tacit knowledge in the development of BW technologies in order to design and implement effective brain drain nonproliferation programs. Until we have a better understanding of these mechanisms, support for conversion activities is the only way to address these critical brain drain concerns.

APPENDIX
AN OVERVIEW OF DEFENSE CONVERSION

I. ECONOMIC FUNDAMENTALS

The term “conversion” has been used rather loosely to describe a number of different changes within defense facilities. Conversion can be simply defined as a shift from military to civilian activities. Behind this simple definition, however, lie various layers of complexity, giving conversion a multitude of faces. In the case of Russia and the New Independent States, additional features from the legacy of the Soviet system complicate the conversion process.

A. Types of Conversion

Conversion of defense enterprises is defined as reallocating resources formerly used for defense purposes towards civilian ends. These resources include personnel, equipment, technologies, buildings, and capital. Historically, conversion has been triggered by four major events, either alone or in combination: (1) the end of a war, (2) a political decision to stop a military program, (3) a decrease in demand for military goods and/or budgets, and (4) a strategic change involving a modification of military doctrines. Depending on the circumstances that generated conversion and the period (postwar or peacetime) during which it occurs, conversion can be a large-scale or small-scale phenomenon. Conversion can also take place at two different levels —at the macro-economic or micro-economic level—and be completed in a short or long time frame. The section below highlights the main characteristics of these different aspects of conversion.

1. Micro-Economic Conversion

Conversion is defined as micro-economic when it takes place at the facility level, e.g., when the share of civilian activities increases in relation to defense activities within the facility. Defense activities are stopped or reduced, and new civilian activities are started.[192] Within the

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[192] Micro-economic conversion can also result from the expansion of civilian activities previously existing at the facility. Many times, defense enterprises possess units that produce civilian goods, although these are frequently physically and financially separate from the military activities. Furthermore, micro-economic conversion can be partial or complete. Micro-economic conversion is said to be partial when only a portion of the resources are reused for civilian purposes. For instance, when a biological research center maintains its defense activities, although at a

facility, the resources that were formerly used for defense purposes are shifted to civilian purposes. For example, when a biological facility shifts from the production of biological weapons to the production of vaccines for public health, this is a micro-economic conversion.[193]

Micro-economic conversion does not imply that the former defense facility must directly re-use or convert all its original resources for civilian purposes. Resources can be sold (equipment), rented (buildings), licensed (technologies), or transferred to other civilian enterprises (personnel). As long as these resources are used for civilian purposes, this is conversion. In addition, some of these resources may be destroyed if they cannot be reused. For instance, contaminated equipment will generally be destroyed, and personnel with a too-narrow specialization may be fired.

2. Macro-Economic Conversion

Conversion is said to be a macro-economic phenomenon when the reallocation of resources takes place at the level of the economy, not at the facility-level. In this case, the total share of military activities in the economy decreases and the share of civilian activities in the economy simultaneously increases. Unemployment in one region or sector may be offset by gains elsewhere.[194] Resources can be converted by destruction (facility closure, equipment destruction) or transferred to a civilian field. Generally, macro-economic conversion involves local, regional, state, and/or federal authorities, which participate directly in the conversion process.

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decreased level, and uses a portion of its resources to start new civilian activities or expand existing civilian activities, this is partial conversion. A complete conversion implies the end of defense-oriented activities with a total shift to civilian activities. For instance, when a biological weapons facility completely stops producing antibiotics for the army and starts using <u>all</u> its resources to fill orders for a civilian hospital, this is a complete conversion.

[193] Note that when a biological facility shifts from the production of biological weapons to the production of vaccines for the army, this is not considered as a conversion, since the client remains a military entity.

[194] For instance, a major strategic change, like disarmament, can lead to a decrease in military expenditures. This event will cause a decrease in the amount of weapons ordered and can lead to the closure of state defense production sites and military bases. In defense-dependent regions, such actions will have repercussions on the level of economic activity. The closure of defense enterprises and military bases also indirectly affects the civilian side of these regional economies. To prevent an economic crisis and the creation of large pockets of unemployment, government authorities typically provide support to compensate for the loss of economic activity in the defense and civilian fields. For example, they can design various types of incentives to encourage job creation and boost civilian activities, such as tax exemptions for new businesses, financial support for the creation of small and medium-size businesses (SMBs), financial support for the creation of jobs in existing SMBs, and/or creation of technical innovation centers (incubators/technoparks).

3. Post-War and Peace-Time Conversion

Conversion can happen during a post-war period or in peacetime. A post-war conversion is usually a large-scale macro-economic phenomenon that involves the entire economy of a country. When a major war ends, the economy is demobilized. Defense expenditures in the state/ federal budgets are sharply decreased, and civilian and military personnel demobilized. Facilities that were temporarily converted to military production during the war to meet defense needs, return to their pre-war civilian activities (re-conversion). Military facilities and equipment created during the war to meet defense needs are generally destroyed or sold if not needed in peacetime. Sometimes, but rarely, some defense facilities are preserved and converted to new civilian activities (micro-conversion). Usually under these circumstances, the government implements a reconstruction policy to support and accelerate the recovery of the civilian economy.[195] Generally, however, the attempts to convert defense facilities (micro-conversion) have been unsuccessful.[196]

In peacetime, conversion may be caused by a decrease in demand for military goods or a decrease in military budgets, indicating a shift in economic priorities. In this case, conversion will usually be a micro-economic phenomenon, where the shift from military to civilian activities will take place within defense facilities. In reality, conversion will take place only if the decrease is significant enough to encourage facilities to shift towards civilian activities. Few defense enterprises have shifted to the civilian sector by starting new civilian activities or acquiring existing civilian enterprises. In fact, most of them reinforced their positions on the military market through mergers and alliances. The internal reallocation of resources towards civilian activities rarely took place, either because the existence of defense facilities was not

[195] For example, the large-scale macro-economic conversion implemented in the United States after World War II is typically considered to be the most successful example of conversion in recent history because it allowed a quick transition from a war-time economy to a peace-time economy without causing major disturbances (e.g., large unemployment, economic crisis). This success was due to a carefully planned process at the national level, involving the gradual demobilization of personnel and significant financial support from the state and federal governments to promote conversion and economic recovery. It is important to note, however, that the U.S. government had started planning for this demobilization long before entering the war. In part from lessons learned after World War I, this advance planning prevented massive unemployment by controlling the glut of former military personnel entering the job market. Furthermore, the economic boom created by the war provided additional resources that were used to finance conversion projects and helped the general shift from a wartime economy to a peacetime economy. Ballard Jack Stokes, *The Shock of Peace* (Washington, DC: University Press of America, 1983).

[196] Alexander J. Davidson, "Military Conversion Policies in the USA: 1940s and 1990s," *Journal of Peace Research* 31, no. 1 (1994): 19-33.

endangered (i.e., they were still needed for defense purposes) or because it was considered too costly. In this context, conversion mainly concerned the downsized personnel who eventually found jobs in other sectors of the economy or received unemployment benefits. Conversion in peacetime can also be the result of strategic changes, which bring about a change in military doctrines.

For instance, disarmament agreements and the end of the Cold War generated changes in the U.S. nuclear doctrine, with important decreases in military expenditures. As a result, the share of defense activities in the economy decreased and defense facilities had to adjust individually to the decrease in the defense budget and in demand for military goods. Therefore, conversion in the United States in the 1990s was both a micro- and macro-economic phenomenon, with the federal and state authorities providing assistance for the macro-economic component. For instance, in 1992, eleven states had adopted or were in the process of adopting laws regulating conversion. These included legislative provisions such as mandatory advance notice of planned lay-offs, technical and financial support to employees and communities hit by conversion, as well as financial incentives to encourage the creation of new businesses in these communities. In addition, municipalities created more than 5000 Local Economic Development Organizations to help absorb the shock of conversion. However, similar to the situation in European countries, very few cases of micro-economic conversion have been observed in the United States. U.S. defense facilities generally preferred consolidating their positions on the defense market by concentrating their activities on a narrow military sector. Some facilities exited the military sector altogether, for instance by closing their defense components. As in Europe, the lack of micro-conversion in the United States is attributed to the cost of conversion, which was considered too high given a stable market environment that could absorb the downsized personnel.[197]

B. Commercial vs. Non-commercial Conversion

The cost of conversion can be born by facilities or by the community. In the case of macro-economic conversion, the cost of conversion is usually borne collectively by the commu-

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[197] Arie Zacks, "Diversification et reconversion de l'industrie d'armement," *Les dossiers du GRIP*, no. 165 (January 1992): 32; Ethan B. Kapstein, "The Economic Transition in Defense-dependent Regions of Russia," *Defense and Peace Economics* 6 (1995): 253-61.

nity. This involves the direct intervention of federal, state, regional or municipal authorities, which provide the financial or technical support required in the conversion process.

In case of micro-economic conversion, the cost of conversion can be born by facilities individually or collectively by the community. When a micro-economic conversion is initiated and implemented by the state, and aims to meet collective needs, the cost of conversion is usually borne by the community. In this case, the facility need not look for the funds required to perform its conversion as they are given by the state. This type of micro-economic conversion is usually non-commercial as the new civilian activities are not subject to market forces. The conversion of the former U.S. BW facility at Fort Detrick into a cancer research center is a good example of non-commercial micro-economic conversion. The nomination of a private contractor to manage the facility created more cost-effective management practices without dramatically altering the culture of the facility.[198]

Conversely, when conversion is implemented by facilities, and aims to transform a former defense facility into a civilian business, conversion takes on a commercial character. In this case, the cost of conversion is usually borne individually by facilities. Even if authorities provide a certain amount of financial or technical support, the burden of finding the resources required to implement conversion lies on the facility's management. This commercial aspect of conversion is often overlooked. Yet this is a major stumbling block on the road to conversion because traditional defense facilities do not operate in a competitive market. As described below, defense facilities also have a specific culture, management style, and structure that prevent them from functioning properly in a market environment.

C. Characteristics of Defense Facilities

The defense industry is generally considered as a nest for technological innovation, which may have civilian applications. We could conclude from this that defense facilities have ready assets that can facilitate their conversion. This would be true if conversion had to take place only on the technical front. Because of the nature of military goods, however, the characteristics of the defense market are very different from those of the civilian market. The manage-

[198] U.S. General Accounting Office, *Problems Associated with Converting Defense Research Facilities to Meet Different Needs: The Case of Ft. Detrick* (Washington, DC: U.S. General Accounting Office, February 1972).

ment style prevailing in the defense field places defense facilities at the other end of a spectrum, far from civilian businesses practices. In this context, defense conversion involves not only a reallocation of resources to the civilian field, but also a major cultural shift.

1. Nature of Military Goods

One of the main characteristics of modern military goods is that they are designed not as separate products to be used independently, but to be part of complex weapons systems. These systems include various components, which are interdependent.[199] Each element of the system has a specific function, and a faulty component[200] may compromise the efficiency of the whole system. During a war, this may cause the death of many soldiers and defeat by the enemy, with lasting repercussions beyond the battlefield. Because of the military's mission and the lives of its personnel, military goods are designed and built to achieve high quality and maximum performance. This quest for performance implies important investments in research and long years of development.[201] Simultaneously, in order to maintain a technological edge, research has to be continuous, with existing weapon systems regularly modernized. They are usually produced in small quantities, which seldom cover the cost of the original investment or allow economies of scale. As a result, the determining factor in the decision to produce military goods is maximum performance, not the cost of production, which is usually covered by the client (state).[202]

In contrast, on the civilian market, the cost of production is the determining factor in the decision to produce. Depending on the market segment, quality and performance are subordinate to the cost of production. For instance, goods like TV sets or CD players with varying quality/

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[199] For instance, aircraft carriers constitute naval systems with four main elements: (1) the aircraft carrier itself, which holds about 5000 people and constitutes the cornerstone of the system, (2) helicopters and fighter planes carrying bombs and missiles, to protect the carrier in the air, and conduct military operations, (3) surface ships (destroyers, cruisers, frigates) with guns, missiles and radar systems, to ensure the defense of the carrier on the surface, and (4) submarines, which ensure the underwater protection of the carrier. All of these elements work together to reach a common objective; a communications network connects all the elements of this system.

[200] By faulty, we mean design or production fault. Designers plan for failure caused by circumstances (e.g., battle, accident, weather) by incorporating back-up or redundant elements into the system and each component. For instance, the aircraft carrier USS *Enterprise* has five nuclear reactors that can serve as back-ups if one of them fails.

[201] The average development cycle of military goods—from design to production—ranges from 10 to 15 years.

[202] Note, however, that since the late 1980s many states have developed measures to stop the regular increase in the cost of weapons.

performance/price ratios—ranging from poor to excellent—can co-exist on the market. The consumers will select the goods that meet their financial and technical requirements. This concept of varying quality and prices is foreign to defense facilities. Converting these facilities to the civilian field will require them to accept the idea that high quality/high performance goods are not necessarily preferred or needed by consumers.

2. A Non-Competitive Market

The military market is not a competitive market. On the demand side, it has only one client—the state—who defines the rules and controls the market. On the supply side, there are usually a limited number of producers who often hold a monopoly in specific products and have the ability to develop complete systems. In France, for instance, there is one main producer per segment of the defense industry; in the United States, producers tend to specialize in specific types of equipment.[203]

The characteristics of the military market are due to the nature of military goods. The cost of R&D and the length of the development cycle limit the number of producers and create barriers to entry. They also create barriers to exit, as continuity is required, which implies the permanence of certain facilities. This is one of the reasons why government agencies in charge of procurement tend to deal with a limited number of producers/designers and ensure them regular profits in exchange for high quality goods. In this way, the state saves on transaction costs (i.e., systematic evaluation of producers' performances, comparison of prices, delivery schedules, firms' reputations) which it would incur in a competitive market. This is quite different from most civilian markets, where the supply side is composed of a large number of producers who compete for shares of the market. In this context, profits are not guaranteed and the survival of producers depends on their ability to face competition and adjust to the changes in demand, which can be volatile.

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[203] Note that, due to cultural and historical reasons, there are major differences in national military markets. For instance, the French market is highly non-competitive and concentrated, whereas the U.S. market is less concentrated and allows more competition. However, competition in the United States takes place only at the level of R&D contracts; experience shows that when a firm obtains the R&D contract, it also obtains the production contract. Jacques S. Gansler, *Affording Defense* (Cambridge: MIT Press, 1989).

3. A Peculiar Culture

The nature of military goods and the special relationship existing between defense producers and the State generate a unique culture that can be qualified as "performance culture." This culture is also reinforced by the rules regulating military production imposed by the State and military. Indeed, the military usually imposes strict specifications and production norms, while the state imposes operating rules that do not exist on the traditional market (i.e., secrecy, controls on production and sales).[204]

At the same time, defense facilities have had to develop a certain expertise and skills to process government contracts and negotiate with their particular client. Acquisition of this knowledge is facilitated by the fact that industry representatives and state representatives often have the same backgrounds. For example, in France, these individuals usually come from the same schools; in the United States, they rotate from industry to government and vice-versa. This creates an environment where the client's needs and desires are well known and predictable. The type of expertise and skills that defense enterprise managers have are very different from those needed on a competitive market, where consumer preferences are changing and have to be analyzed (i.e., market research) to make sure that the supply is in tune with the demand. Consequently, conversion of defense enterprises requires an adjustment of their managers' skills and expertise to fit the needs of a market economy. This can be achieved by a retraining of existing managers, the hiring of experts of the chosen market, and/or by a complete change in management.

4. Financial Specificity

Military programs and their financial support are planned in the long-term. For instance, in the United States, military programs are integrated into the federal budget and included in the National Defense Authorization Act every fiscal year. Once a military program is started, its financial support is generally guaranteed. For instance, in France, military goods production is financed through "reimbursable advances," whereas in the United States production is usually based on cost-reimbursable contracts. Changes in designs of military goods and increases in

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[204] Kenneth L. Adelman and Norman R. Augustine, "Bulldozing the Management," *Foreign Affairs* 71, no. 2 (1992): 24-47.

costs during the development or production process are also common. These changes, however, are usually agreed upon through a negotiation between the client and the producer/designer. Because of the cost and length of R&D and the limited number of producers, pulling out of a program due to unplanned price increases would be very costly for the state.[205] In this context, once a contract is obtained, the control over the negotiations shifts from the client to the producer. This is very different from a competitive market environment, where the client usually remains in control and can more easily shift to a different producer when the characteristics of the goods change (i.e., price, quality, technical specifications, performance).

5. Specificity of Location

Defense industries are usually concentrated in a limited number of regions due to economic and strategic considerations. In general, the location of any industry is based on economic imperatives (i.e., proximity to raw materials, clients, existence of labor and transportation systems). As far as the defense industry is concerned, strategic motivations also play an important role in determining their location.[206] Strategic considerations may also lead to establishing defense facilities far from economic/financial centers. Such factors can serve as major obstacles to conversion as remotely located defense facilities may encounter difficulties in accessing potential clients and markets.

As a result of all of the unique characteristics described above, defense facilities are not fit to operate in a civilian competitive market environment. Instead, they traditionally operate in a relatively protected environment where performance is more important than cost, and where their client, who is known and predictable, ensures their survival. Transforming defense facilities into civilian businesses requires their adaptation to a parallel universe—a universe where cost becomes a major element of decision, where competitiveness ensures their durability, where competition is high and sales techniques are almost as important as the product itself, and where clients are numerous and changing.

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[205] This is why it is usually extremely difficult to cancel military programs, even when they are not needed or have performance problems.

[206] For instance, production sites need to be located close enough to potential battlefronts in order to allow for continuous supply, while also being located far enough to avoid vulnerability against an invasion or concentrated strike. The proximity of testing grounds is also essential. Naval enterprises are usually located by the sea to allow for testing of ships under real conditions.

Therefore, conversion of defense facilities will require major adjustments in terms of structure, culture, behaviors, and financial practices. The facilities will also need to acquire sufficient flexibility to adjust to changes in demand and face competition. The degree of flexibility required is a function of the goods that the facility chooses to produce.[207] In short, the further away from its original activities and market a defense facility chooses to place itself, the greater will be the adjustment, financial investment, and time required to perform conversion. In this context, it is not surprising that when facing the need to convert, European and American defense facilities have either preferred to avoid the process by: (1) exiting the military market, (2) consolidating their positions on the military market, or (3) adopting an activity where the state remains a major partner.

D. Distinctive Characteristics of Soviet Defense Facilities

At first sight, the characteristics of Soviet defense facilities are similar to those of defense enterprises in market economies: (1) strong ties with their unique client, who controlled, regulated, and financed their production; (2) a product—military goods—which had to obey specific norms; (3) a peculiar structure and culture; and (4) a specific location. A closer examination, however, reveals that these features have been modified by Soviet culture and ideology, producing marked differences with those observed in western countries. This section identifies the specific features of the Soviet defense industry that will constitute additional obstacles to conversion.

1. A Peculiar Structure

The Soviet defense industry was composed of very large organizations called "Scientific Production Associations"(Nauchno-Proizvodzvenoe Obedinenie, or NPO), which specialized in the production of a specific weapons system (e.g., naval, aviation, tanks). Typically, NPOs in-

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[207] For instance, if a defense facility chooses to turn to consumer goods production, it will need a high degree of flexibility to face its numerous competitors and adjust to the changes in demand, which can be volatile. On the other hand, if it chooses to produce more specialized goods, like high-tech medical equipment, it will probably need a lower level of flexibility, as there will be fewer competitors in this market and demand may be more stable. Some other goods, such as basic and applied research, require a lower level of flexibility because the client is usually the state. In this case, the client will probably be a government agency (i.e., Ministry of Health) whose characteristics are different from defense facilities' traditional partners (i.e., Ministry of Defense). However, since the new customer remains a state entity, it will operate according to similar rules; continued work for the state will require little adjustment for defense facilities.

cluded a large research institute, generally located in the European part of Russia, and various production sites scattered all across the former Soviet Union. NPOs had from 50,000 to 100,000 personnel on their payroll. The individual facilities comprising the NPOs were also characterized by their large size. For example, research institutes employed on the average 2,000 people, with production sites employing about 10,000 people. Each production site was itself divided into several entities that could be located in the same city or in different towns.

Soviet defense facilities were also social agents, organizing education, health, and leisure services. They were in charge of building, maintaining, and financing local hospitals, clinics, kindergartens, schools, universities, summer camps, amusement parks, sports centers, theaters, movie theaters, housing, agricultural farms, and other social infrastructures. These services were open to their own employees as well as to the other residents of their communities and regions.

2. Mobilization, Specialization, and De-specialization

"Redundancy" was one of the principles on which the Soviet defense industry was based. Soviet military strategists believed that the country had to be prepared to fight a war as soon as it was declared and to maintain this ability during the hostilities. This idea gave birth to the concept of peacetime mobilization, under which defense and civilian facilities were structured and operated as in a wartime context. For defense industries, this led to the creation of oversized facilities, which produced large quantities of military goods. Production sites and research institutes also had "twins," located in other cities or regions of the Soviet Union, which duplicated their activities. The purpose of this strategy was to ensure the supply of military goods, should one of the twins be destroyed during a war.

The Soviet division of labor also commanded that NPOs form production chains distinct from one another. These chains would consist of members that were specialized in a specific stage of the production process (i.e., assembling, production of specific parts, research, development). However, owing to the deficiencies of the Soviet supply network, NPO members unofficially developed side activities and formed a web of ties with other entities of separate NPOs. This arrangement lessened the impact of the Soviet system deficiencies on each NPO's activities and also met local needs.[208] As a result, each member of the NPOs was both specialized, due to the distribution of work imposed by the NPOs, and de-specialized, due to their side activities.

3. Dual-purpose Facilities

Soviet defense facilities were also dual-purpose entities, usually composed of a military component and a civilian component. This duality often served the purpose of secrecy, as the civilian activity could help cover the military activity. At the same time, however, defense facilities were also the central element of the Soviet production system as they produced a sizable share of the civilian goods.[209] For instance, the defense industry had a monopoly or quasi-monopoly in the production of a certain number of consumer goods (e.g., TV sets, sewing machines, radio sets, washing machines, refrigerators) as well as other specialized goods (e.g., civilian aircraft, communication equipment).[210] This duality may be viewed as an advantage when it comes to conversion. However, the civilian goods were usually of poor quality, as they were perceived to be of secondary importance in relation to military goods. Civilian production was also perceived by many defense directors as a means to maintain a pool of personnel that could be transferred to the military component when production needed to be accelerated, usually at the end of the plan period.[211] The rotation of personnel from military to civilian activities and vice-versa is uncommon in western defense facilities, where boundaries between military and civilian components are clear.

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[208] For instance, if a defense enterprise needed a specific part or piece of equipment that could not be supplied in the right quantity or quality by the other member of the NPO normally responsible for this, ties could be made with another local enterprise that was part of a different NPO. It was also common for defense enterprises to start new productions, which had no link with their original activities, in order to provide goods that were in demand in the community or region. Officially, these types of side activities were not permitted, but they were tolerated. For a description of the Soviet system, see Clifford C. Gaddy, *The Price of the Past: Russia's Struggle With the Legacy of a Militarized Economy* (Washington, DC: Brookings Institution Press, 1996).

[209] Ibid.

[210] Sonia Ben Ouagrham, "La Conversion des Enterprises de Defense en Russie: Une Analyse Regionale," (Ph.D. diss., Ecole des Hautes Etudes en Sciences Sociales, 1999).

[211] The Soviet economy was based on a 5-year plan system.

4. Location

The location of Soviet defense facilities was primarily based on strategic imperatives and often went against economic logic. As mentioned above, NPOs consisted of large research centers located in the European part of Russia, mostly Moscow and St. Petersburg, and productions sites usually located east of the Urals. This type of organization, however, implied that facilities were dependent for supplies on distant NPO members, sometimes located thousands of kilometers away. In order to protect the secrecy of their work, some facilities were located in isolated areas, where no other activity existed. This led to the creation of factory towns that were often closed, with no economic links with neighboring communities. In other cases, facilities were located in areas that were incoherent from the point of view of their production. For instance, some naval enterprises were located in regions with no access to a major river or to the sea. This type of location would increase the cost of conversion, because it sharply increased operating costs at the facility.

5. A "Culture of Quantity"

Similar to their western counterparts, Soviet defense facilities did not generate a culture of cost. Unlike western facilities, however, they developed a culture of quantity, not a culture of performance. Indeed, in the 1930s the Soviet leaders used a military build-up as a means to offset the weakening of the economy caused by collectivization and internal political tensions. For defense enterprises, this resulted in an extensive development mode, aimed at compensating for the weaknesses of the economic and industrial base. It translated into the development of simple weapon systems with low unit costs, but which were difficult to modernize. As a result, the total cost of military production was higher in the West, even though the unit cost of military goods was lower.[212]

6. Implication for Conversion

Like their western counterparts, Soviet defense facilities are not fit to operate in a market environment. Their unique characteristics create additional difficulties for these facilities to operate in a market economy. For instance, the size of Soviet defense facilities increases their

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[212] Sonia Ben Ouagrham, "La Conversion des Enterprises de Defense en Russie."

operating costs. Their organization in NPOs further increases their operating and production costs, due to the expense of transporting supplies and final products to and from distant regions. Under the NPO structure, the specialization of these facilities in one stage of a production chain limits the range of choices and flexibility for conversion activities. On the other hand, despecialization (accumulation of unrelated activities) of these facilities also leads to a dispersion of scarce resources, which compromises their conversion. The duplication system developed in the Soviet Union created a situation in which there is an excess of production capabilities, implying that many of these defense facilities will probably face competition with their former "twins." Finally, as former Soviet defense facilities have favored quantity over quality, they will face tremendous difficulties in competing with foreign enterprises in an open market.

7. Additional Obstacles

As if all of the above characteristics did not pose overwhelming hurdles to conversion, Soviet defense facilities have to face additional obstacles created by the dissolution of the USSR and its transition to a market economy. The break-up of the USSR, and the political and economic reforms launched simultaneously in 1992, not only resulted in the disruption of Soviet industrial production networks but also generated a high level of economic instability. Public expenditures were dramatically decreased, leaving defense enterprises without state support. The banking system, due to its nascent development, could not provide relief to defense facilities. This situation, which continues today, forces defense facilities to rebuild their production networks (i.e., find new partners, new suppliers, new clients) and perform their conversion with no financial support from the state. Moreover, this must be done in an environment that is in constant flux.

A second consequence of the break-up of the Soviet Union was that conversion was launched without prior demilitarization. Generally, when a facility is converted to civilian use, it is first demilitarized; e.g., defense activities are stopped or decreased, and the resources unique to military activities, including personnel, equipment, and buildings, are destroyed or converted. Owing to the sudden dissolution of the USSR and the simultaneous implementation of economic and political reforms, conversion was launched without a prior demilitarization. As a result, the burden and cost of demilitarization lies on the shoulders of individual facilities. Yet in an economic crisis and with no outside funding, demilitarization cannot take place because there are no potential candidates in the economy to absorb the excess resources, including personnel.

Another outcome of the break-up of the USSR was the destruction of the NPO infrastructure and the disorganization of the communications system. Indeed, as mentioned earlier, many of defense facilities' partners were located in other republics of the Soviet Union, now independent, or in remote regions. Without state support, the cost of maintaining such links was too high for individual facilities. This eventually deprived defense facilities of their network of suppliers and partners.[213] The destruction of the NPO infrastructure implies that defense facilities have to reorganize their production network, e.g., find new partners, suppliers and clients in order to be able to convert. At the same time, the defense facilities need to maintain a certain level of activity in order to keep their skilled workers, make some type of profit, and increase their chances of conversion. This is quite a challenge when former economic ties have been cut, new ties have not yet been forged, and the economic environment is unstable. In addition, in many regions, especially east of the Urals, it is not easy to envision or create new economic ties. Some cities/regions are dependent on a small number of facilities whose activities, technologies, and skills may not be compatible. The isolated location of some facilities, far from economic and industrial centers, makes contacts with new partners or clients difficult. This situation further compromises the chances for conversion.

In spite of the economic logic that necessitates the closing of unproductive/unprofitable enterprises, Soviet defense enterprises cannot be immediately closed even if they fail to convert. The main reason for this paradox lies in their importance to the national production infrastructure: shutting these facilities down would deprive the country and/or regional economies of their industrial backbone. Unlike western countries, civilian enterprises in the Former Soviet Union cannot replace the defense industry in the economy for three main reasons. First, the longevity (about 60 years) of the Soviet peace-time mobilization system resulted in decreasing the contribution of the civilian economy. Second, the behaviors and routines specific to any mobilized economy (i.e., hoarding of resources, administrative competition in the allocation of resources,

[213] Clearly, such a system would have been too expensive to maintain in a market environment, and it is very likely that it would have eventually crumbled. Yet the preservation of this system in the short term would have helped defense facilities maintain a certain level of activity while simultaneously designing new activities for their conversion and looking for new partners to implement these plans.

artificial inflation of resource needs) have become norms both in the Soviet civilian and defense industry. This implies that, unlike the western civilian sector, Soviet civilian industry is not more efficient economically than defense industry, and therefore cannot serve as an example nor as a locomotive for conversion. Third, the Soviet economy became structurally mobilized, which implies that the transition to a civilian economy cannot take place without important state investment to build the required infrastructures. For instance, the Soviet transportation system was built to bring resources from the eastern and southern parts of the USSR to its western part where the battles were to take place. As a result, inter-regional transportation systems east of the Urals remained underdeveloped. Today, this situation does not allow a sufficient mobility of goods and labor. Finally, due to the transition to the market, all converting Soviet defense facilities have to start operating as commercial enterprises and become profitable. In other words, they have to endure the most difficult conversion path, so far avoided by western defense facilities.

II. SPECIAL CHARACTERISTICS OF BW FACILITIES

In addition to the factors noted above, all biological weapons facilities possess special characteristics that influence their conversion. These characteristics are distinct from those facing conversion of nuclear or chemical defense facilities and encompass technical, financial, and environmental considerations. It is important to understand these differences to appreciate the complexities involved in converting these facilities. For comparison, we will also discuss the historical precedents of conversion involving former BW facilities in Western countries. As we will illustrate, however, these examples are problematic for comparison with the current situation facing BW facilities in the former Soviet Union.

A. Technical Issues

Technical issues involved in converting BW facilities to peaceful purposes include a consideration of not only the existing equipment and materials, but also the scope, configuration, and prior BW activities within a particular facility. Other related issues that need to be addressed before starting new commercial activities include the need for remediation of contaminated areas, necessary upgrades or renovations, and determination of operating costs. All of these factors play a role in determining the prospects and pathways for conversion of a BW facility.

1. Possibilities: Reallocating Available Resources

Former BW facilities typically possess a large quantity of standard biotechnology equipment useful for growing and processing pathogens and other biological materials (see Table A-1). Most of this equipment is considered dual-use.[214] Specific equipment varies by facility depending on whether bacterial or viral agents were formerly studied or produced. It is possible

Table A-1: Some Equipment Found in BW Facilities

Equipment	Use
Fermentors Bench top (up to 3 L) Laboratory Scale (5-50 L) Pilot Scale (50-1000 L) Industrial Scale (> than 1000 L)	Growth of bacterial cultures
Bioreactors (i.e., hollow fiber)	Cell culture system to grow viruses
Lyophilizers	Freeze drying of microorganisms for storage
Centrifugal Separators	Allow for continuous separation of pathogenic microorganisms without the propagation of aerosols
Cross Flow Filtration	Allow for continuous separation of pathogenic
Microencapsulation Equipment Interfacial polycondensors Phase separators	Coats droplets or particles of agent with thin layer of protective material to prevent environmental degradation or particle clumping; can produce small (1-25 micron) particle sizes (aerosol droplets)
Milling equipment	Machines producing microorganisms in the 1-25 micron size.
Biosafety equipment Glove boxes, Safety cabinets Clean air rooms, HEPA filter units	Barriers used to promote safe work/handling with microorganisms
Aerosol chambers	Chambers designed for aerosol testing using microorganisms, viruses, or toxins; study of varying environmental conditions on agent and/or effect of agent on animals
Aerosolization equipment, spray nozzles	Capable of producing particles in the 1-25 micron size
Autoclaves	Sterilization of equipment, media
Ovens	Drying of glassware or dry weights, melting agar
Incubators/Shakers	Cultivation of stock cultures and production of inocula
HPLC/GC	Analytical product separation

[214] For a list of dual-use equipment, see http://www.australiagroup.net/index.html, accessed 1 December 2001.

to envision reallocating some of these existing material resources for new commercial or research activities. As an example, the 20,000-gallon fermentors from the former U.S. Vigo BW production facility were sold to the Pfizer pharmaceutical company and reused for the production of veterinary antibiotics.[215] In addition, by the 1970s, laboratories from the former BW experimental production plant at Porton Down in Britain were used by the commercial company Cadbury-Schweppes (of chocolate fame) to study various aspects of cocoa-related fermentations.[216]

Culture collections are perhaps one of the most valuable material assets present at former BW facilities. BW facilities generally possess a wide range of pathogens and other bacterial and viral strains. These strains have a number of commercial applications. For example, bacterial and viral strains could be used in the development of diagnostics, vaccines, or antibiotics for medical purposes. Moreover, many bacterial strains can be particularly adaptable for commercial uses. These include the production of microbial biomass (yeast, single cell protein as food supplements), microbial enzymes (useful in the food, chemical, textile industries), and microbial metabolites (vitamins, alcohols, acids). Bacteria can also be used to improve production processes of many high value compounds (steroids, antibiotics) and in remediation of contaminated areas. Such uses are relevant for environmental, human, plant, and animal products and applications. In addition, other existing raw materials and resources such as water, oxygen, and energy formerly used in BW production can be utilized in commercial activities.

The material resources are not the only assets within BW facilities. Organizational and personnel resources also influence the prospects for conversion of a BW facility. Typically, BW facilities are classified as either research or production facilities. Frequently, however, strict differentiation between these two categories is not always possible. Some research facilities may have only conducted basic research on pathogens whereas others may have possessed small-scale production capabilities. For example, although the State Research Center for Virology and Biotechnology (VECTOR) in Russia is a premier viral research center, it also possesses pilot scale bioreactors. On the other hand, some large BW production facilities have had substantial

[215] Regis, *The Biology of Doom*, p. 224. See also note 238.

[216] Peter Hammond and Gradon Carter, *From Biological Warfare to Healthcare: Porton Down 1940-2000* (New York: Palgrave, 2002), p. 133.

basic research and weaponization divisions. Prior to 1969, the U.S.'s Fort Detrick offensive BW facility had large-scale production and testing capabilities, as well as research divisions in aerobiology, immunology, and bacteriology, and other biological sciences.[217] Because the line between research and production facilities is often blurred, it is important to look at each facility individually to evaluate its resources and capabilities for conversion to commercial activities. We can, however, outline some important distinctions between BW research and production facilities.

BW production facilities range in size and scope, but would bear some resemblance to civilian pharmaceutical, vaccine, or beer production facilities. Typically, these are large industrial facilities, composed of many large building and utility infrastructures devoted to producing thousands to tens of thousands of liters of material. In terms of personnel, BW production facilities can employ hundreds, if not thousands, of workers. For example, at the Pine Bluff BW production complex, 300 people were involved in the offensive activities.[218] The majority of the staff at production facilities would consist of industrial biologists and their technical support staff (e.g., biological plant operators). Other staff could include scientists such as microbiologists, virologists, biochemists, chemists, physicists, as well as biological, chemical, and mechanical engineers.

In contrast to production facilities, BW research facilities tend to be smaller in terms of industrial equipment and production capabilities. BW research facilities can, however, consist of several large buildings with a significant amount of high-containment laboratory space, which could be used to support existing activities or renovated to support lower containment activities. These research facilities can also support a number of scientific personnel studying a variety of bacterial and viral pathogens. For example, at its peak in the 1980s the VECTOR facility had more than 4000 total employees, with 300 devoted exclusively to pathogen research, and another

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[217] In fact, Fort Detrick, with 460 individual structures and 1.8 million square feet of laboratory space, was considerably larger that the Pine Bluff production facility, which only had 33 buildings and 41,000 square feet of laboratory space. U.S. General Accounting Office, *Problems Associated with Converting Defense Research Facilities to Meet Different Needs: The Case of Ft. Detrick* (Washington, DC: U.S. General Accounting Office, February 1972): 13, 16.

[218] U.S. General Accounting Office, *Problems Associated with Converting Defense Research Facilities*, p. 9.

1000 employees studying the molecular biology of a variety of viruses.[219] Typically, the majority of scientific personnel at these facilities would have advanced training in basic and applied biological research, with a smaller number having industrial training.

Since biotechnology is inherently dual-use, the scientific personnel at former BW research and production facilities could adapt their prior training and knowledge to work with other non-pathogenic microorganisms. In contrast to the technology behind nuclear weapons, the potential application of biotechnology is vast. In addition, because many of these facilities possess both research and production capabilities, a number of new activities could be envisioned spanning the research to production spectrum. Converting scientific researchers to become industrial scientists (and vice versa) would require additional training. This characteristic is not unique to the BW field, but is a necessary criterion for conversion in many technology sectors.

Converting BW facilities and equipment for peaceful production of drugs or vaccines to benefit public health has been touted as a highly desirable goal.[220] In part because many former BW facilities previously conducted some biodefense work to protect military troops, there is a belief that these biodefense or other medically related products can be easily produced and sold on the commercial market. This outcome, however, is rare. To understand why, we must examine the challenges involved in producing commercial public health products.

2. Problems: Quality Control and Contamination

Some of the problems stem from the rigorous standards necessary for the production of public health products. For example, pharmaceutical production for sale on an international market requires rigorous standards and quality control involving Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP).[221] These practices consist of rules and regulations

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[219] Sergey V. Netesov, “The State Research Center of Virology and Biotechnology VECTOR for the Prevention of Misuse of Biological Sciences,” personal communication by Milton Leitenberg to Kathleen M. Vogel April 2000.

[220] Alan Zelicoff, “The Dual-Use Nature of Biotechnology: Some Examples from Medical Therapeutics,” in *Director’s Series on Proliferation*, no. 4, ed. K.C. Bailey (Livermore: Lawrence Livermore National Laboratory, 23 May 1994).

[221] For a good discussion of the hurdles involved in turning a BW facility to pharmaceutical production see Jack Melling, “Pharmaceutical and Regulatory Aspects of Conversion,” in *Conversion of Former BTW Facilities*, pp. 101-33; Jack Melling, “Vaccines Against Dual-Threat Agents: Regulation and Quality, Issues and Constraints,” in *Control of Dual Threat Agents*, pp. 139-47.

gover/ning all aspects of production such as organization, personnel, buildings, facilities, equipment, control of components, drug product containers, laboratory controls, production and process controls, packaging and labeling controls, holding and distribution, records and reports.[222] Such practices ensure the integrity and safety of pharmaceuticals and other biological products from the beginning to end of production.

These practices, however, require a standard of control and operation that far exceeds those used in former BW research or production activities. For example, there are stringent criteria for the quality of steam, water, and air that come in contact with the product and the equipment used in a GMP production process.[223] The introduction of these new quality control processes may require significant changes in the existing production line. Retrofitting an existing facility to meet these requirements is often tedious and costly. Even if conversion activities are conducted off-site, significant personnel training will be needed to comply with GMP/GLP protocols. Also, the facility will need national and international accreditation. In order to maintain production standards, employees and plant processes will need to be continually monitored for performance and quality control. Attaining international accreditation, however, may not be necessary to support some conversion efforts. If the identified market is national, only national production standards may be required.

Furthermore, there must be definitive proof that no contamination remains from BW agents where new activities will take place. This poses a difficult challenge to conversion. Since these facilities have been used to produce large quantities of agent, conduct aerosol tests, and fill munitions, contamination of buildings and equipment is usually widespread. If evidence of contamination exists, the equipment and buildings may be prohibited from being used in certain commercial activities. For example, in the United States, equipment that has been previously used in work with spore-forming bacteria, such as anthrax bacteria, cannot be used for pharmaceutical production involving non-spore forming bacteria.[224] If, however, contaminated equip-

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[222] George Robertson, "Development of Biopharmaceutical Manufacturing at Fort Detrick, Maryland," in *Conversion of Former BTW Facilities*, pp. 80-87.

[223] Gary Walsh, *Biopharmaceuticals: Biochemistry and Biotechnology* (Chichester: John Wiley & Sons, 1998), p. 91.

[224] Melling, "Pharmaceutical and Regulatory Aspects of Conversion," in *Conversion of Former BTW Facilities*, p. 112.

ment and buildings are to be re-used, this frequently involves costly and lengthy decontamination procedures.[225] Frequently, this factor is under-appreciated in considering the requirements for conversion of former BW facilities.[226] In many cases, it may be better to purchase new equipment for conversion activities and/or move new activities off-site of the former weapons complex. However, since former BW facilities include several buildings never involved in weapons production (e.g., nutrient media production, infirmaries, warehouses), new activities could be re-located to these "clean" areas.

3. Problems: Production Costs

Another important prerequisite for conversion involves a detailed study of the total investment necessary for the new activities. As an example, let us examine some of the cost issues encountered in commercial fermentation processes. Fermentation products are usually classified as either low cost-high volume or high cost-low volume.[227] Although many BW production facilities have large-scale fermentors that would be suited for low cost-high volume productions, this type of production may not be feasible from a market perspective.[228] There are only a limited

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[225] For example, decontamination and renovation efforts to turn the Pine Bluff BW facility into a National Center for Toxicology Research cost $10.8 million (in 1977 dollars). These cost estimates do not mean to imply that future decontamination efforts at other BW facilities will be equally costly; they do, however, indicate that some significant investment will be necessary to re-use buildings and equipment formerly involved in weapons activities. Building 470, the anthrax production facility at Fort Detrick, was decontaminated three times. In spite of this, the review team could not state that the building was 100 percent clean, due to the persistent nature of the spore-forming anthrax bacteria. Therefore no plans were made to convert this facility. Norman M. Covert, *Cutting Edge: A History of Fort Detrick, Maryland, 1943-1993* (Fort Detrick: Public Affairs Office, Headquarters U.S. Army Garrison, 1993), pp. 48-49; Senate Committee on Human Resources, *Examination of Serious Deficiencies in the Defense Department's Efforts to Protect the Human Subjects of Drug Research: Hearings before the Subcommittee on Health and Scientific Research of the Committee on Human Resources*, 95th Cong., 1st Session, 8 March and 23 May 1977 (Washington, DC: U.S. Government Printing Office, 1977), p. 229.

[226] However, contamination issues are also a problem in conversion of other defense facilities (chemical, nuclear, missile) where toxic substances or toxic by-products are used or generated.

[227] These two categories can be further subdivided: (1) low price bulk chemicals (e.g., solvents, biomass, high fructose syrups that cost US$$10^2$ to 10^3/ton); (2) mid price chemicals (e.g., organic acids, amino acids, biopolymers that cost US$$10^3$ to 10^5/ton); (3) high price microbial and animal-cell products (e.g., enzymes, vitamins, antibiotics, corticosteroids, vaccines that cost US$$10^5$ to 10^7/ton); (4) very high price animal cell products (e.g., monoclonal antibodies, tissue plasminogen activator that cost US$$10^7$ to 10^9/ton). These last two categories can only be produced by a microbial or animal-based process. Peter F. Stanbury, Allan Whitaker, and Stephen J. Hall, "Fermentation Economics," in *Principles of Fermentation Technology*, 2nd ed. (Oxford: Pergamon, 1995), p. 334.

[228] Accurate, detailed costs associated with specific industrial fermentation processes and products are not widely published, but some studies are available which outline general costs. Typically, these costs involve four main factors (in decreasing importance): raw materials, fixed costs, utilities, and labor. Raw materials, such as media or

number of low cost-high volume products produced by fermentation. These include solvents, organic acids, and single cell protein. Unfortunately, for many of these products the microbial process is less economical than chemical production.[229] In contrast, more opportunities may exist for high cost-low volume products. These products would include compounds that have a complex or unstable structure, or are too expensive to produce by chemical methods. Antibiotics, steroids, amino acids, and vitamins fall into this category.

For certain processes, utilities may constitute a major share of the operating expenses. For example, large requirements for steam, heating, cooling, aeration, agitation, water usage, and waste treatment may significantly increase utility costs.[230] For former BW production facilities the high utility costs associated with heating and lighting the large production area, running large-scale fermentors, and using inefficient process streams not originally designed for commercial activities pose difficulties for conversion.[231] Renovations of existing facilities would need to be organized to minimize expenses associated with these factors.[232]

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solvents, may take up from 38 to 70 percent of the entire production costs. The unit cost of a bulk product is also affected by the fermentation yield, process productivity, and purification demands. Compared to other expenses, labor is typically a small portion of the overall costs for production and this reduces some of the incentives to employ FSU employees. See L.K. Nyiri and M. Charles, "Economic status of fermentation processes," *Ann. Rep. Ferm. Processes* 1 (1977): 365-81.

[229] M. Pape, "The competition between microbial and chemical processes for the manufacture of basic chemicals and intermediates," in *Microbial Energy Conversion: The Proceedings of a Seminar*, ed. H.G. Schlegal and J. Barnea (Oxford: Pergamon Press, 1977), pp. 510-30.

[230] William H. Bartholomew and Harold B. Reisman, "Economics of Fermentation Processes," in *Microbial Technology*, 2nd ed., ed. H.J. Peppler and D. Perlman (Academic Press: New York, 1979), pp. 463-96.

[231] Former BW research facilities can consist of several large buildings with a significant amount of high-containment laboratory space. Continuing to maintain and run such laboratories will incur a high lifetime operating cost. For example, maintenance, repair, and use of the Biosafety Level 3 maximum containment biodefense research laboratory at Dugway Proving Grounds in the United States was estimated to cost in excess of $1 million per year in 1990. Dynamic Corporation, *Supplement to the Draft Environmental Impact Statement: Biological Aerosol Test Facility. New Alternative Action to Construct and Operate a Consolidated Life Sciences Test Facility at Dugway Proving Ground, Utah* (Dugway: Department of the Army, Dugway Proving Ground, November 1990).

[232] In some cases, improvements or developments in strains and media can increase yields and decrease some utility costs associated with particular products. Government assistance, either in terms of money, supplies, or tax relief, could help support some fermentation processes. For example, U.S. agricultural aid programs provided low-cost supplies of grain and potatoes for fermentation processes that were previously cost-prohibitive in the current market. See D. Perlman, "Some Prospects for the Fermentation Industries," *Wallerstein Communications* 33 (1970): 165-73.

B. Political Climate

In addition to the economic principles, the prevailing political climate can have a profound influence on conversion. As described above, conversion of defense facilities can be supported by a political or strategic decision made by a state to stop or decrease a military program (i.e., disarmament). In the case of biological weapons, the decision of a country to become a state party to the Biological and Toxin Weapons Convention (BTWC) can provide the impetus to close or convert former offensive BW facilities. However, as the following section will show, due to the time period when the BTWC was negotiated, its content, and subsequent entry into force, the declaration of existing (or recent) offensive BW facilities for conversion is problematic. This situation holds particular relevance for former Soviet BW facilities.

1. Arms Control Aspects

The Biological and Toxin Weapons Convention, which entered into force in 1975, was the first international treaty to ban a whole class of weapons of mass destruction.[233] Specifically, the BTWC prohibits the development, production, stockpiling, and transfer of BW agents and technology for warfare purposes. Article II of the Convention is explicit in its requirement for dealing with BW related materials:

> Each State Party to this Convention undertakes to destroy, or to divert to peaceful purposes, as soon as possible but not later than nine months after entry into force of the Convention, all agents, toxins, weapons, equipment and means of delivery specified in Article I of the Convention, which are in its possession or under its jurisdiction or control. In implementing the provisions of this article all necessary safety precautions shall be observed to protect populations and the environment.[234]

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[233] The United Kingdom was one of the first countries to propose a separate international treaty to deal with biological weapons. Prior to the U.K. proposal, the general international consensus was to try to deal with chemical and biological weapons under one combined treaty. In 1968, the United Kingdom began to publicly argue that since biological weapons and chemical weapons were so different, particularly in terms of verification, it was better to focus international efforts on dealing with the problem of biological weapons first because it was the most despised class of weapons. See Ambassador James F. Leonard, "The Control of Biological Weapons: Retrospect and Prospect," in *Inspection Procedures for Compliance Monitoring of the Biological Weapons Convention*, ed. J.B. Tucker (Livermore: Lawrence Livermore National Laboratory, December 1997), pp. 21-26.

[234] "Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and On Their Destruction," at http://www.state.gov/www/global/arms/treaties/bwc1.html, accessed 18 October 2001.

Facilities where such agents are developed, produced, stockpiled, or weaponized, however, are not explicitly mentioned in the Convention. During the original BTWC negotiations, no proposals on conversion were submitted. This is in sharp contrast to the Chemical Weapons Convention (CWC), which specifically outlines procedures and protocols for dismantlement and conversion of facilities.[235]

It is difficult to say why the BTWC never included a requirement for conversion, although there are at least two plausible explanations. First, there was no requirement for declarations involving facilities and prior offensive activities, nor any on-site verification measures, written into the draft Convention.[236] Without this information, it would have been difficult to identify facilities and differentiate a change from offensive to legitimate activities. Typically, the same materials and much of the equipment used to make biological weapons can also be used to

[235] The Chemical Weapons Convention states in Article V that upon entry into force, chemical weapons production facilities must close and be destroyed within 5-10 years depending on the former use of the facility. Conversion of facilities is approved only on a case-by-case basis and must be completed within six years after entry into force of the CWC.

[236] One of Yugoslavia's proposals suggested a declaration of all facilities that could engage in prohibited activities. This suggestion was never incorporated into the final draft treaty. Also, in the treaty negotiations there were a number of proposals submitted for a range of possible verification measures. At the time, however, the Soviet Union was opposed to on-site verification, and so there was no possibility of including these in the Convention. It was only at the 1986 Second Review Conference that Confidence Building Measures (CBMs) were adopted. The CBMs would be politically binding, but not mandatory, mechanisms to exchange information between States Parties to the Convention on high-risk laboratories, research, and unusual outbreaks of disease. CBMs involving declarations on past offensive programs were not adopted until after the 3rd Review Conference in 1991. For more information and analysis of these measures see, Arms Control and Disarmament Agency, "Yugoslav Working Paper Submitted to the Conference of the Committee on Disarmament: Elements for a System of Control of the Complete Prohibition of Chemical and Biological Weapons, 6 August 1970" in *Documents on Disarmament* 1970 (Washington, DC: U.S. Government Printing Office, 1970), p. 383; Erhard Geissler, ed., *Strengthening the Biological Weapons Convention by Confidence-Building Measures*, Vol. 10, SIPRI Chemical and Biological Warfare Studies (Oxford: Oxford University Press, 1990); Milton Leitenberg, "Biological Weapons Arms Control," pp. 2, 43-53; Nicholas Sims, *The Diplomacy of Biological Disarmament: Vicissitudes of a Treaty in Force, 1975-1985* (New York, St. Martin's Press, 1988), pp. 52-60; Marie Isabelle Chevrier and Iris Hunger, "Confidence Building Measures for the BTWC: Performance and Potential," *Nonproliferation Review* 7, no. 3 (Fall-Winter 2000): 24-42; Jez Littlewood, "Chapter Two: The Biological and Toxin Weapons Convention," unpublished manuscript.

make vaccines or other medical treatments for diseases.[237] Therefore, "conversion" of a BW facility would have been difficult to assess.[238]

Second, in 1969, prior to the BTWC treaty negotiations, the United States unilaterally renounced its biological weapons capability, followed shortly with the destruction of stockpiles and conversion of facilities.[239] By the time the treaty entered into force in 1975, no other country had specifically disclosed past offensive activities or facilities.[240] As stated previously, Article II requires that all former BW capabilities be destroyed or diverted to peaceful purposes within nine months of the treaty's entry into force. Since the U.S. government was already in the process of converting its facilities by 1971 and no other countries had declared facilities, the question of conversion among other state parties was moot. After 1976, any remaining evidence of facilities needing conversion would have indicated retention of an offensive capability—a clear

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[237] In spite of this, the multilateral Australia Group has defined materials and equipment that would be particularly useful for BW production. The Australia Group was established in 1984 as an informal and voluntary gathering of nations designed to limit proliferation of dual-use materials and technologies that could be used in development of chemical and biological weapons. There is no formal charter or constitution, and therefore no formal coordination, monitoring, or enforcement of policies. However, the Group does have informal agreements to share intelligence information and notice of export denials, and works to harmonize national export control policies. In 1992, the Australia Group decided to add to its control list organisms, toxins, and equipment that could be used to make biological weapons. In addition to the Australia Group, individual countries have developed their own national export control policies regarding sensitive BW equipment and technologies. See http://www.australiagroup.net/index.html, accessed 1 December 2001. Furthermore, there are "signatures" for detecting potential BW activity which relate to funding, personnel, facility design equipment, security, biosafety, and process flow. See Milton Leitenberg, "Biological Weapons and Arms Control," pp. 54-58.

[238] This was evident in the disastrous 1994 Russian-U.S.-U.K. trilateral visit to the U.S.'s WWII-era Vigo BW production plant in Terre Haute, Indiana. After the war, the plant had been sold to the Pfizer pharmaceutical company. Although the fermentors were used to make penicillin for a few years, Pfizer soon abandoned the old buildings and built a new drug manufacturing facility nearby. When the Russian delegation saw the fermentation capability of both the abandoned and new facilities, they charged that the U.S. government was maintaining BW production. Although these charges were not true and were never credibly substantiated, they were difficult to convincingly refute. For a description of this event, see Mangold and Goldberg, *Plague Wars*, pp. 200-08.

[239] Matthew Meselson, Martin M. Kaplan, and Mark A. Mokulsky, "Verification of Biological and Toxin Weapons Disarmament," *Science & Global Security* 2 (1991): 241.

[240] In 1991, states parties to the BTWC agreed to Confidence Building Measures that included declaration of past offensive activities. Under these measures, Canada, France, Russia, the United Kingdom, and the United States declared past offensive programs. Except for Russia, all of these countries ended their offensive activities before the entry into force of the BTWC. In addition, these countries, aside from Russia, have met the requirements under Article II by closure (sealing), conversion, destruction, dismantlement, or a combination of these. See Geissler et al., eds., *Conversion of Former BTW Facilities*, pp. 209-10; Chevrier and Hunger, "Confidence Building Measures for the BTWC," p. 32; Erhard Geissler and John Ellis van Courtland Moon, *Biological and Toxin Weapons: Research, Development and Use from the Middle Ages to 1945*, SIPRI Chemical and Biological Warfare Studies, no. 18 (Oxford: Oxford University Press, 1999).

violation of the Convention. As a result of these factors, conversion never obtained widespread support within the BTWC negotiations or early Review Conferences.

Since 1973, only Russia and the Former Soviet Republics have declared the existence of recently active offensive BW facilities (from the USSR period) and the need for international assistance to support their dismantlement and conversion.[241] In spite of the number of facilities composing the former USSR BW complex, Ad Hoc Group meetings have failed to discuss conversion issues either as an independent concern or within the framework of technical cooperation (Article X) under the treaty.[242] Iris Hunger, professional secretary to the Ad Hoc Group, speculates that since conversion would apply only to a limited number of states, it has not been prioritized by the Group compared with other issues that affect a larger number of states parties. Hunger also explains that conversion has not been considered as part of Article X because such technical cooperation has been targeted to countries with limited biotechnological capability and not those with former BW programs. There has also been an implicit consensus that conversion should be the sole responsibility (financial and otherwise) of the individual states concerned. It is clear that the former Soviet BW program operated and was expanded after the USSR signed and ratified the BTWC and for at least 25 years after the treaty's entry into force.[243] Therefore, conversion of former Soviet BW facilities is likely to be a thorny issue for state parties to the Convention.

Some of these same issues, however, have been dealt with in the CWC, where conversion has been specified. It is likely that conversion has not been revisited under the Ad Hoc Group due to the historical precedent and the priority of resolving larger and more difficult verification concerns. Some state parties to the CWC have found the approval process for conversion to be

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[241] This again is a difference with respect to the Chemical Weapons Convention (CWC), under which ten countries have declared chemical weapons production facilities. Such a discrepancy between the two conventions is probably explained by the time period when these treaties entered into force. The CWC entered into force only in 1997, whereas the BTWC has been in force for almost 30 years. Iris Hunger, "Facilitating the Conversion of BTW Facilities Through International Technical Cooperation: BTWC Implications," in *Conversion of Former BTW Facilities*, pp. 195-97.

[242] Since 1995, the Ad Hoc Group of Government Experts has met to consider potential verification measures in the development of a legally binding instrument to strengthen the BTWC.

[243] Milton Leitenberg, "Biological Weapons Arms Control," *Contemporary Security Policy* 17, no. 1 (April 1996): 53-79.

costly, tedious, and slow. Perhaps these experiences have also lowered the incentive for lobbying for conversion measures in the current BTWC Protocol negotiations.

2. Problems: Biodefense Work[244]

In the past few years, there has been growing interest in redirecting Soviet bioweaponeers to develop new biodefense products to protect civilian and military populations. In the United States, this interest has been enhanced since September 11th and the anthrax attacks. Biodefense work would involve the least amount of effort for redirection for former bioweapons scientists since such work would use many of the same pathogenic organisms, similar protocols, techniques, and existing expertise formerly used in offensive activities. Therefore, in theory, new biodefense activities would be a quick and straightforward way to jump start former BW scientists to peaceful work.

This strategy, however, has its dark side. Although the intent of a defensive program is different from an offensive program, biodefense work still retains components of an offensive BW program.[245] The differences between offensive and defense work can be ambiguous, particularly on the research end of the spectrum (see Figure A-1). However, the ambiguity decreases as one moves from the research bench to production activities, with the differences involving the amount of agent produced, whether the agent remains virulent or is attenuated, process differences between vaccine and weapons production, and the level of secrecy surrounding the

[244] Biodefense work is defined here as the development of medical diagnostics and treatments (e.g., antibiotics and vaccines) to detect biological agents and defend military and civilian populations against biological weapons. Note: if a former BW facility engages in defensive work for only the military (e.g., customer is the military), then no conversion has occurred. However, if the facility also is able to sell a vaccine to protect civilians then this can be considered conversion. For example, the anthrax vaccine can be given to a variety of individuals in high-risk environments. This includes not only soldiers, but veterinarians, farmers, and employees of industries dealing with animal hides and products (e.g., wool-sorters).

[245] David L. Huxsoll, *Global Spread of Chemical and Biological Weapons*, Hearings before the Committee on Governmental Affairs and its Permanent Subcommittee on Investigations, U.S. Senate, 101st Cong., 1st Sess. (Washington, DC: U.S. Government Printing Office, 1990), p. 201. For an interesting discussion of the risks of defensive work see Jonathan King and Harlee Strauss, "The Hazards of Defensive Biological Warfare Programs," in *Preventing a Biological Arms Race*, ed. Susan Wright (Cambridge: MIT Press, 1990), pp. 120-32.

work.[246] In this blurred context, stringent oversight or verification measures could help clarify that new activities are legitimate.

The problem with verification of legitimate versus illicit activities within a former BW facility has been raised in international negotiations to develop a legally binding Protocol to the BTWC. If adopted, the Protocol would provide for specific verification measures such as declarations, visits, investigations, and provisions for international cooperation. These measures will allow for monitoring of ongoing activities at former BW facilities and high-risk laboratories. Unfortunately, however, negotiations for a new Protocol were suspended at the 5th Review Conference (November 2001) at the request of the U.S. government delegation. Negotiations have adjourned and delegations to the Ad Hoc Group are scheduled to meet in November 2002 to determine the future of the Protocol. Due to the current lack of U.S. support for the existing Protocol, and the lack of political will among other states parties to override U.S. objections, it is unlikely that the Protocol will ever be adopted.[247]

With no legally binding verification measures, it is impossible to certify with 100 percent assurance that no biodefense research within former BW facilities is being redirected towards offensive ends. Since many BW research and production facilities are large, covert activities could continue. Therefore, reallocating resources to conduct biodefense work at a former BW facility could raise suspicions detrimental to securing commercial investment for conversion. Full transparency into biodefense work can help alleviate these suspicions. Unfortunately, transparency is still a problem in certain countries. For example, the international community still has limited or

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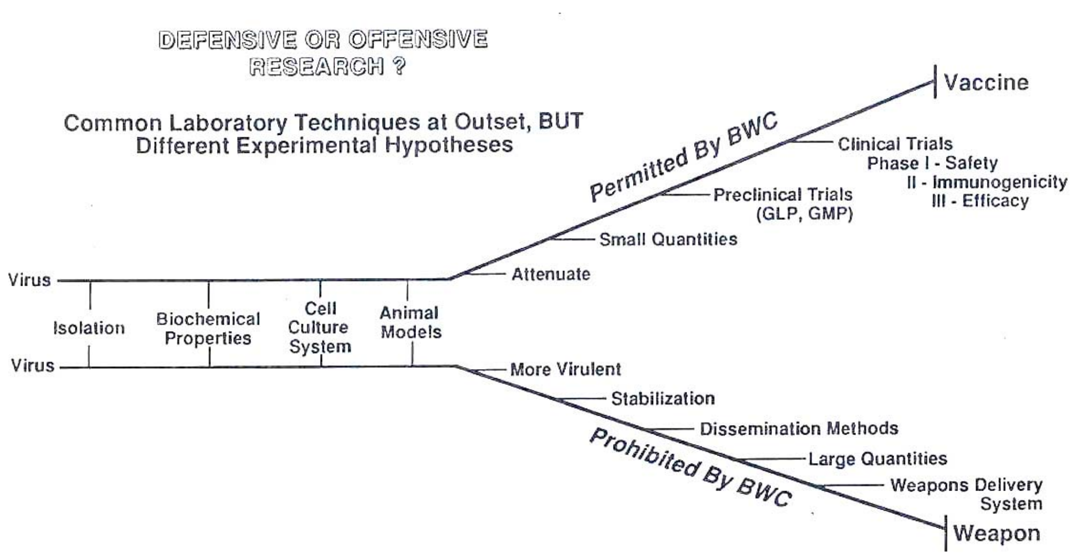
[246] In 1993, the U.S. Armed Forces Medical Intelligence Center further expanded these characteristics and created a set of five categories to assess whether a facility was involved in offensive work. These categories examined: (1) funding and personnel; (2) facility design, equipment, and security; (3) scientific work; (4) safety conditions; and (5) process flow. See "Signatures for Biological Warfare Facilities, Armed Forces Medical Intelligence Center, 1993, as cited in Milton Leitenberg, "Biological Weapons Arms Control," pp. 55-58; Barry J. Erlick, *Global Spread of Chemical and Biological Weapons*, Hearings before the Committee on Governmental Affairs and its Permanent Subcommittee on Investigations, U.S. Senate, 101st Cong., 1st Session (Washington, DC: U.S. Government Printing Office, 1990), pp. 33-42.

[247] There still exists, however, support within the national and international community to adopt unilateral or multilateral mechanisms to address compliance issues such as creating global disease surveillance networks, establishing United Nation's procedures for investigating suspicious disease outbreaks, and enacting national criminal legislation. Although these measures will not provide for verification of activities within former BW facilities, they serve as useful tools.

no transparency to several Soviet BW facilities, particularly those remaining on Russian territory.[248]

Figure A-1: Defensive Versus Offensive Research



Source: David L. Huxsoll, *Global Spread of Chemical and Biological Weapons*. Hearings before the Committee on Governmental Affairs and its Permanent Subcommittee on Investigations, United States Senate, 101st Cong., 17 May 1989 (Washington, DC: U.S. Government Printing Office, 1990): 522.

In light of these problems, it might be best for a former BW facility to stop or significantly downsize its biodefense work in order to remove any doubts about continuing illegal activities. Yet, many former BW facilities find it easiest to switch their work from offensive to defensive. Study of conversion efforts at Ft. Detrick shows that senior biological warfare specialists (those working for 10-15 years on weapons work) had the most difficulty in redirecting to totally new research activities since their experiences were not readily adaptable.[249] A 1997 National

[248] Three Russian Ministry of Defense facilities located in Yekaterinberg (formerly Sverdlovsk), Kirov, and Sergiev Posad (formerly Zagorsk) remain closed to the international community.

[249] Martha Raver, "The Sword Gone, What of the Warriors? Detrick Scientists Look to the Future," *Frederick News-Post*, 19 October 1971.

Academy of Sciences report used this argument in their recommendations to support a handful of biodefense research projects in initial U.S. government engagement of Soviet BW facilities.[250]

Although bilateral and multilateral agreements could be designed and implemented to monitor new biodefense activities, they would be limited in their ability to prevent the future leakage of this knowledge by a rogue scientist or group of scientists, the so-called "brain drain" proliferation threat. Employing former BW scientists to continue defensive work maintains their skill base of knowledge on dangerous pathogens and weapons-related work, which can pose long-term proliferation risks.[251] Therefore, it is important to recognize that complications and trade-offs exist when a former BW facility chooses to conduct defensive work as part of its conversion strategy.

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[250] U.S.-Russian Collaborative Program for Research and Monitoring of Pathogens of Global Importance Committee, *Controlling Dangerous Pathogens: A Blueprint for U.S.-Russian Cooperation* (Washington, DC: U.S. National Academy of Sciences, 1997).

[251] Milton Leitenberg, "The Possibilities and Limitations of Biological Weapons Conversion" in *Conversion of Former BTW Facilities*, pp. 125-31.